Phase I RFI/RI Work Plan

Woman Creek Priority Drainage Operable Unit No. 5

EG&G ROCKY FLATS

Manual 21100-WP-OU 05.1

Volume I

ADMIN RECORD

A-0U05-000059

FINAL

PHASE I RFI/RI WORK PLAN

Revision 1

ROCKY FLATS PLANT

WOMAN CREEK PRIORITY DRAINAGE
(Operable Unit No. 5)

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden, Colorado

ENVIRONMENTAL RESTORATION PROGRAM

February 1992

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VOLUME I – TEXT

ADMIN RECORD

ATTACHMENT
for Work Plan OU-5 Woman Creek Priority Drainage

- Insert new cover pages for each volume, and insert new spines with your copy number on it.

- Insert new Table of contents, and detailed Table of Contents and destroy old TOC.

- Insert new Executive Summary and destroy old ES.

- Insert new pages and **destroy old corresponding page numbers.**

    - Insert page 1 of section 1.
    - Insert new section 2.
    - Insert page 1 of section 3.
    - Insert section 4 - all new except tables which need to be kept (pages 4-4 - 4-5 and 4-8).
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    - Insert page 1 of section 11.
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Any questions please call Carlotta Muheim at 966-3893.

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LIST OF ACRONYMS

The following is a list of acronyms used throughout this work plan.

ACL	Alternative Concentration Limit
AEC	Atomic Energy Commission
ARAR	Applicable or Relevant and Appropriate Requirements
AWQC	Ambient Water Quality Criteria
BCF	Bioconcentration Factor
BNA	Base-neutral acid extractable organics
BRAP	Baseline Risk Assessment Plan
CAD	Corrective Action Decision
CCR	Colorado Code of Regulations
CDH	Colorado Department of Health
CEARP	Comprehensive Environmental Assessment and Response Program
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CMP	corrugated metal pipe
CMS	corrective measures study
CRP	community relations plan
CWA	Clean Water Act
DOE	Department of Energy
DQO	data quality objective
EEP	Environmental Evaluation Plan
EIS	Environmental Impact Statement
EM	electromagnetic
EPA	Environmental Protection Agency
ER	environmental restoration
ERDA	Energy Research and Development Administration
FIDLER	Field Instrument for Detection of Low Energy Radiation
FS	feasibility study
FSP	field sampling plan
GAC	granular activated carbon
GC	gas chromatograph
GRRASP	General Radiochemistry and Routine Analytical Services Protocol
HSP	Health and Safety Plan
HSU	Hydrostratigraphic unit
IAG	Interagency Agreement
IHSS	Individual Hazardous Substance Site
IRIS	Integrated Risk Information System
MCL	maximum contaminant level

LIST OF ACRONYMS (cont.)

MCLG	maximum contaminant level goal
MSL	mean sea level
NCP	National Contingency Plan
NPDES	National Pollutant Discharge Elimination System
PARCC	precision, accuracy representativeness, completeness, and comparability
PCB	polychlorinated biphenyl
PCE	tetrachloroethylene
PID	photoionization detector
QAA	Quality Assurance Addendum
QA/QC	Quality Assurance/Quality Control
QAPjP	Quality Assurance Project Plan
RAAMP	Radioactive Ambient Air Monitoring Program
RCRA	Resource Conservation and Recovery Act
RFEDS	Rocky Flats Environmental Database System
RFI	RCRA facility investigation
RI	remedial investigation (CERCLA)
ROD	Record of Decision
SAS	Special Analytical Services
SAP	sampling and analysis plan
SARA	Superfund Amendments and Reauthorization Act of 1986
SID	South Interceptor Ditch
SDWA	Safe Drinking Water Act
SOP	Standard Operating Procedure
SOPA	Standard Operating Procedure Addendum
TAL	target analyte list
TBC	to be considered
TCA	trichloroethane
TCE	trichloroethylene
TCL	target compound list
TDS	total dissolved solids
TIC	tentatively identified compounds
TOC	total organic carbon
UV	ultraviolet
VOA	volatile organic analysis
VOC	volatile organic compounds
WQC	Water Quality Criteria
WQCC	Water Quality Control Commission

TITLE: Executive Summary

DRAFT DOCUMENT

Approved By:
Name (Date) 2/29/92

EXECUTIVE SUMMARY

This document presents the work plan for the Phase I RCRA Facility Investigation (RFI)/Remedial Investigation (RI) of the Woman Creek drainage (Operable Unit Number 5) at the Rocky Flats Plant, Jefferson County, Colorado. This work plan includes a field sampling plan (FSP) that presents the investigation planned to evaluate the presence or absence of contamination at Individual Hazardous Substance Sites (IHSSs) within the Woman Creek drainage. The FSP developed in this work plan is based on the requirements of the Interagency Agreement (IAG) amongst the Department of Energy (DOE), Environmental Protection Agency (EPA), and the State of Colorado Department of Health (CDH), and what additional work is needed to initially assess each IHSSs. Ten IHSSs are located in Operable Unit Number 5 (OU5). They are the Original Landfill (IHSS 115), the Ash Pits (IHSSs 133.1-133.4), the Incinerator (IHSS 133.5), the Concrete Wash Pad (IHSS 133.6), Detention Ponds C-1 and C-2 (IHSSs 142.10 and 142.11), and the Surface Disturbance (IHSS 209). Two additional surface disturbances have been identified and included in this work plan. These areas are located south of the Ash Pits and west of IHSS 209.

The schedule and the sequence of work for completing the OU5 investigation is specified in the IAG and is outlined below to provide background on the requirements for the OU5 RFI/RI. The IAG states that each OU may proceed through several phases of investigation dependent on the information gathered to characterize the OU (Section I.B.9, IAG Statement of Work). For OU5, the Original Landfill (IHSS 115) is the only IHSS that, *a priori*, will require a subsequent phase(s) of investigation. Due to its size and potential complexity, plans for detailed source characterization of IHSS 115 are best formulated using the results of the Phase I investigation that is designed to determine the IHSS boundaries and whether contaminant release is occurring. Other IHSSs may require a subsequent phase(s) of investigation pending the Phase I results in order to better characterize the nature and extent of contamination for the RCRA Corrective Measure Study (CMS)/CERCLA Feasibility Study (FS) and Baseline Risk Assessment (BRA). However, such subsequent phases are not envisioned at this time.

Following completion of the Phase I work plan, the IAG requires that the results of the Phase I RFI/RI for OU5 be documented within a draft Phase I RFI/RI report. This draft RFI/RI report will include a Preliminary Site Characterization and will also recommend work to be performed for the Phase II investigation, if required. The IAG specifies that this draft Phase I report be submitted to EPA and the State for review, and DOE will address the regulatory agency's comments and submit a Final Phase I RFI/RI report for EPA and/or State approval.

The IAG specifies that the priority and schedule for the Phase II RFI/RI investigations for OUs 3, 5, 6, 8, 12, 13, 14, 15, and 16 will be determined after evaluating the Final Phase I RFI/RI Reports for the operable units. If EPA and/or the State determine that no further investigatory work is required for OU5 after the Phase I investigation is complete, EPA and/or the State shall approve the Final Phase I RFI/RI Report as a Final RFI/RI Report. The field investigations for OU5 will be considered complete after approval of a Final RFI/RI Report.

Section 1.0 of this work plan presents introductory information and a general characterization of the region and plant site. In addition, the regional geology and hydrology at Rocky Flats are discussed. Section 2.0 presents descriptions of the site physical characteristics, histories and previous investigations, available information concerning the nature and extent of contamination, and conceptual models for the IHSSs. This initial characterization forms the basis for establishing data needs, data quality objectives (DQOs), and developing an FSP for each IHSS. Section 3.0 presents applicable or relevant and appropriate requirements (ARARs) developed for OU5. Section 4.0 establishes data needs and DQOs considering site characteristics and conceptual models of each IHSS in OU5. Section 5.0 outlines RFI/RI tasks to be performed. Section 6.0 presents the schedule for these tasks. A Field Sampling Plan, based on the requirements of the IAG, is presented in Section 7.0 to satisfy the data needs and DQOs identified in Section 4.0. The Baseline Risk Assessment Plan (BRAP) and Environmental Evaluation Plan (EEP) are presented in Sections 8.0 and 9.0, respectively. A Quality Assurance Addendum (QAA) and Standard Operating Procedure Addenda (SOPA) are presented in Sections 10.0 and 11.0, respectively. A list of references is presented in Section 12.0.

The initial step in the development of the OU5 RFI/RI work plan was a review of existing information. Available historical and background data for each IHSS were collected through a literature search and a review of the Rocky Flats Environmental Database System (RFEDS). Only a few limited investigations have been conducted at OU5 in the past. These investigations include a germanium gamma radiation survey at the Original Landfill (IHSS 115), sediment sampling in Woman Creek, ongoing surface water, groundwater and sediment sampling programs along Woman Creek and the South Interceptor Ditch (SID), and the Plant-wide Ambient Air Monitoring Program.

Data quality objectives have been developed for this Phase I investigation. DQOs are qualitative and quantitative statements that describe the quality and quantity of data required by the RFI/RI. The DQO process is divided into three stages. Through application of the DQO process, site-specific RFI/RI goals are established and data needs are identified for achieving these goals.

After assessing the existing information for OU5, the following objectives of the Phase I RFI/RI have been identified:

- Characterize the physical and hydrogeologic setting of the IHSSs
- Assess the presence or absence of contamination at the sites
- Characterize the nature and extent of contamination at the sites, if present
- Support the Phase I Baseline Risk Assessment and Environmental Evaluation
- Determine contaminant migration rate and transport characteristics

Within these broad objectives, site-specific data needs have been identified based on preliminary identification of contaminants potentially present at each IHSS and the data needs for the Phase I Baseline Risk Assessment and Environmental Evaluation. The FSP presented in this work plan is based on the data needs and the requirements of the IAG. The FSP for each IHSS requires a combination of screening activities, sampling of soils, sediment and surface water, and well installation and sampling. Site-specific FSPs are briefly summarized below.

IHSS 115 - Original Landfill. Screening activities at the Original Landfill will consist of a review of the gamma radiation survey recently completed and completion of a soil gas survey and magnetometer survey. Sampling will include subsurface sampling in borings, and sediment and surface water sampling adjacent to the unit. Wells will be installed and sampled downgradient, of the unit and in selected soil borings if a plume is encountered. An additional activity at the unit will be a study of the pipes protruding from the landfill and sampling of effluent from the pipes, if present.

IHSS 133.1-6 - Ash Pits 1-4, Incinerator, and Concrete Wash Pad. Aerial photographs will be reviewed to identify the extent of disposal areas at the IHSS sites. A radiological survey and magnetometer survey will be the screening activities conducted at the IHSS 133 sites. Surface soil samples will be collected from the locations that have high radiation concentrations identified during the radiological survey. Subsurface samples will also be collected from borings in the Ash Pit areas. Three monitoring wells will be installed downgradient of the units and sampled.

IHSS 142 - Detention Ponds - C-Series. Surface water samples will be collected from several locations in each pond. Sediment samples will be collected in the ponds, as well as along the entire Woman Creek drainage within the Rocky Flats Plant. Sediment samples will also be collected in the SID. Two monitoring wells will be installed and sampled in the alluvium downgradient of each dam at Ponds C-1 and C-2.

IHSS 209 - Surface Disturbance Southeast of Building 881, the Surface Disturbance West of IHSS 209, and Surface Disturbances South of the Ash Pits. Visual inspections of the surface disturbance areas and reviews of historical use information pertaining to these sites will be completed prior to screening and sampling activities. A radiological survey will be completed at each area. Surface soil samples will be collected from the three excavations at IHSS 209, at the five disturbed areas at the surface disturbance west of IHSS 209, and from the north-south excavation at the surface disturbance south of the Ash Pits. A sediment sample and water sample (if water is present) will be collected from each of the former pond areas at IHSS 209. Surface and subsurface samples will be collected from borings in the parallel excavations and the east and west areas at the surface disturbance south of the Ash Pits. Surface samples will be collected at the surface disturbance west of IHSS 209.

Data collected during the Phase I Woman Creek drainage RFI/RI as well as data from other ongoing and planned investigations will be incorporated into the existing RFEDS database. These data will be used to better define site characteristics, source characteristics, and the nature and extent of contamination; to support the baseline risk assessment and environmental evaluation; and to evaluate potential remedial alternatives. An RFI/RI report will be prepared summarizing the data obtained during the Phase I program and containing the Phase I Baseline Risk Assessment and Environmental Evaluation.

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1.0 INTRODUCTION

This document presents the work plan for the Phase I RCRA Facility Investigation (RFI)/Remedial Investigation (RI) of the Woman Creek Drainage (Operable Unit Number 5) at the Rocky Flats Plant, Jefferson County, Colorado. In this work plan, the existing information is initially summarized to characterize Operable Unit Number 5 (OU5) and a field sampling program is presented to assess potential contamination of the ten Individual Hazardous Substance Sites (IHSSs) that have been identified along or within the Woman Creek drainage. These IHSSs include the Original Landfill (IHSS 115), the Ash Pits (IHSS 133.1-133.4), the Incinerator (IHSS 133.5), the Concrete Wash Pad (IHSS 133.6), Detention Ponds C-1 and C-2 (IHSSs 142.10 and 142.11), and Surface Disturbance (IHSS 209). Two additional areas of surface disturbances, one south of the Ash Pits and a second west of IHSS 209, have been included in this OU5 work plan. The Phase I RFI/RI will be conducted in accordance with the Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (U.S EPA 1988a) and Interim Final RCRA Facility Investigation (RFI) Guidance (U.S. EPA 1989a). The data generated will be used to begin developing and screening remedial alternatives and to evaluate the need for further studies for the 10 IHSSs in OU5. The data will also be used to estimate the risks to human health and the environment posed by each hazardous substance site.

This investigation is part of a comprehensive, phased program of site characterization, remedial investigations, feasibility studies, and remedial/corrective actions currently in progress at the Rocky Flats Plant. These investigations are pursuant to the U.S. Department of Energy (U.S. DOE) Environmental Restoration (ER) Program [formerly known as the Comprehensive Environmental Assessment and Response Program (CEARP)]; a Compliance Agreement among DOE, the U.S. Environmental Protection Agency (EPA), and the State of Colorado Department of Health (CDH) dated July 31, 1986; and an Interagency Agreement (IAG) among DOE, EPA, and CDH, dated January 22, 1991. The IAG addresses RCRA and CERCLA issues and has been integrated with the ER Program. In accordance with the IAG, the CERCLA terms "Remedial Investigation" and "Feasibility Study" in this document are considered equivalent to the RCRA terms "RCRA Facility Investigation" and "Corrective Measures Study".

1.1 ENVIRONMENTAL RESTORATION PROGRAM

The ER Program is designed to investigate and clean up contaminated sites at DOE facilities. This ER Program being implemented is organized into five major activities. Activity 1 has already been completed at Rocky Flats Plant (U.S. DOE 1986a). This work plan is part of the Activity 2 program currently in progress for OU5 (Woman Creek drainage).

2.0
PRELIMINARY SITE CHARACTERIZATION

Ten Individual Hazardous Substance Sites (IHSSs), geographically located along or within the drainage areas of Woman Creek (Figure 2-1), have been designated as Operable Unit 5 (OU5). These IHSSs are identified in the Environmental Restoration Interagency Agreement (IAG), dated January 22, 1991, as the Original Landfill (IHSS 115), Ash Pits, Incinerator area, and Concrete Wash Pad (IHSSs 133.1 through 133.6), Detention Ponds C-1 and C-2 (IHSSs 142.10 and 142.11), and a Surface Disturbance (IHSS 209). Ponds C-1 and C-2 are the only IHSSs located on Woman Creek. The remaining eight IHSSs are located along the banks and/or upland areas that drain into Woman Creek or into the South Interceptor Ditch (SID). In addition to these ten IHSSs, two additional surface disturbances will be investigated in the Phase I OU5 investigation, a surface disturbance west of IHSS 209 and a surface disturbance south of the Ash Pits (133).

The initial step in the development of the OU5 work plan was a review of existing information. Available historical and background data for each IHSS were collected through a literature search, which included references at the Rocky Flats Public Reading Room and various libraries within the Rocky Flats Plant, and a review of the RFEDS. Information concerning existing alluvial and bedrock groundwater monitoring wells within the Woman Creek drainage have been collected for this work plan (Table 2-1). Personal communications with plant personnel were also used as a source of information during the background data review so that each IHSS could be better described.

The ten IHSSs are discussed in detail in the following subsections. The location and description of each IHSS, the history of use, surface drainage, nature of contamination, previous investigations conducted at or near the individual IHSSs, geology, and hydrology are discussed. The Ash Pits, Incinerator, and Concrete Wash Pad are grouped together in the following discussions, as are Ponds C-1 and C-2, since these units have interrelated and similar histories. The areal extent and boundary of each IHSS is based on a preliminary review of historical aerial photographs (U.S. EPA 1988b) and the historical operations of the unit. The boundaries for each IHSS in this work plan are the same as those established in the IAG except for the Original Landfill (IHSS 115) and the Surface Disturbance (IHSS 209). The southern boundary of the Original Landfill has been extended approximately 300 feet toward the south across the SID based on a site reconnaissance. The Surface Disturbance boundary was extended to the north and southwest based on a site reconnaissance and aerial photographs. Several investigations are ongoing within the Woman Creek drainage, including surface water, groundwater and sediment sampling and investigations at OUs 1 and 2. Where previous or ongoing investigations have been conducted at or

near an IHSS, some of the analytical data are included for reference in the following sections. The inclusion of these data is for informational purposes only. No conclusions are made in this work plan regarding the presence or absence of contamination based on these data. The geology underlying each IHSS has been characterized by the ongoing geologic characterization program in progress by EG&G at Rocky Flats (EG&G 1990b). This program includes conducting a comprehensive literature search, reprocessing and describing previously obtained core samples, reprocessing previously obtained seismic data, and collecting and analyzing selected sample for grain size analyses. The geologic characterization program will incorporate all geologic information Plant-wide for continued refinement of the working geologic model. The referenced report is a draft internal working document. Data and results of this characterization that are pertinent to Operable Unit 5 are presented in this work plan. In addition to the review of each IHSS, a generic conceptual model for the IHSSs of OU5 has been developed. The generic model will be refined and modified appropriate to each IHSS in the RFI/RI Report.

Also discussed in the following section is the Woman Creek drainage system adjacent to the plant site. Woman Creek is the drainage system that provides a common physical setting for all the IHSSs in OU5.

2.1 WOMAN CREEK AND DIVERSION STRUCTURES

The Rocky Flats Plant is geographically located on a plateau and is bounded on the south by the Woman Creek drainage (Figure 2-1). Woman Creek flows from west to east through the Rocky Flats facility and into Stanley Lake Reservoir and Mower Reservoir about 1 ½ miles from the facility's eastern boundary (Figure 1-2). Woman Creek originates near Coal Creek approximately 1 ½ miles to the west of Highway 93. Near the west boundary of the plant facility, within the buffer zones, Woman Creek crosses under the South Boulder diversion canal. The canal cross over is constructed of wood and presently contributes water to Woman Creek due to leakage. Other waters which enter into Woman Creek within the buffer zone include upstream runoff and water released from the Rocky Flats Lake. Water is released from Rocky Flats Lakes into Woman Creek by a local rancher as part of his water rights agreement. This flow is diverted out of Woman Creek to Mower Reservoir below Pond C-2.

The natural drainage of Woman Creek has been somewhat modified in the OU5 area by the construction of Ponds C-1 (IHSS 142.10) and C-2 (IHSS 142.11) and the SID south of the plant site. Currently, Woman Creek flows eastward through OU5 in its natural stream channel to Detention Pond C-1 (IHSS 142.10) (Figure 2-1). The purpose of Detention Pond C-1 is for stormwater management and for sampling and monitoring of the water upstream in Woman Creek. Water is rarely retained within this pond as the outlet or gate is usually open and the water is allowed to flow through the pond. The water consequently flows in its natural channel until just west of Pond C-2 where it is diverted around Pond C-2 by a diversion canal. Downgradient and to the east of Pond C-2, approximately two thirds of the water is diverted from Woman Creek's main channel into an unnamed ditch to Mower Reservoir. The remaining flow continues to flow downstream in Woman Creek and into Stanley Lake Reservoir.

characteristic of the deposition of Rocky Flats Alluvium on the surface of the Arapahoe Formation. The geology beneath the surface disturbance west of IHSS 209 has also been characterized based on its geographical location, as no wells or borings have been drilled in this area. Therefore, the surficial geologic unit beneath this unit is likely to be Rocky Flats Alluvium underlain by the Arapahoe Formation. Further characterization of the lithology of these formations is, however, needed.

The characteristics of the hydrologic system(s) are unknown beneath these surface disturbances because of the lack of nearby wells. Groundwater probably occurs at the base of the Rocky Flats Alluvium just above the less-permeable Arapahoe Formation; however, further characterization of the nature of the Rocky Flats Alluvium and Arapahoe Formation is needed.

2.6 METEOROLOGY, CLIMATOLOGY, AND AIR QUALITY

The area surrounding the Rocky Flats Plant has a semiarid climate characteristic of much of the central Rocky Mountain region. Approximately 40 % of the 15-inch annual precipitation falls during the spring season, much of it as snow. Thunderstorms (June to August) account for an additional 30% of the annual precipitation. Autumn and winter are drier seasons, accounting for 19% and 11% of the annual precipitation, respectively. Snowfall averages 85 inches per year, falling from October through May (U.S. DOE, 1980). Temperatures are moderate: extremely warm and cold weather is usually of short duration. On the average, daily summer temperatures range from 55°F to 85°F, and winter temperatures range from 20°F to 45°F. The low average relative humidity (46%) is due to the blocking effect of the Rocky Mountains.

Wind, temperature, and precipitation data are collected on the plant site and summarized annually. Table 2-8 presents the 1990 annual summary of the percent frequency of wind directions (16 compass points) divided into 6 speed categories. These frequency values are represented graphically in Figure 2-10. Winds at the Rocky Flats Plant are predominantly northwesterly. Winds greater than 4.18 meters per second (m/s) (9.2 miles per hour [mph]) with easterly components occur with a low frequency. The Pasquill Stability Class D represents the prevailing meteorological conditions for the Rocky Flats Plant (EG&G, 1991), and average downwind directional frequencies.

Special attention has been focused on dispersion meteorology surrounding the Plant due to the remote possibility that significant atmospheric releases might affect the Denver metropolitan area, which is located in the predominant downwind direction (southeast). Studies of air flow and dispersion characteristics (e.g., Hodgin, 1983 and 1984) indicate that winds come down from the mountains to the west, turn and move toward the north and northeast along the South Platte River valley and pass to the west and north of Brighton, Colorado (U.S. DOE, 1980), which is just north of Denver.

TABLE 2-8

ROCKY FLATS METEOROLOGICAL MONITORING STATION
60 METER TOWER

January 1, 1990 –December 31, 1990

Wind Frequency Distribution by Percent –Stability Class D

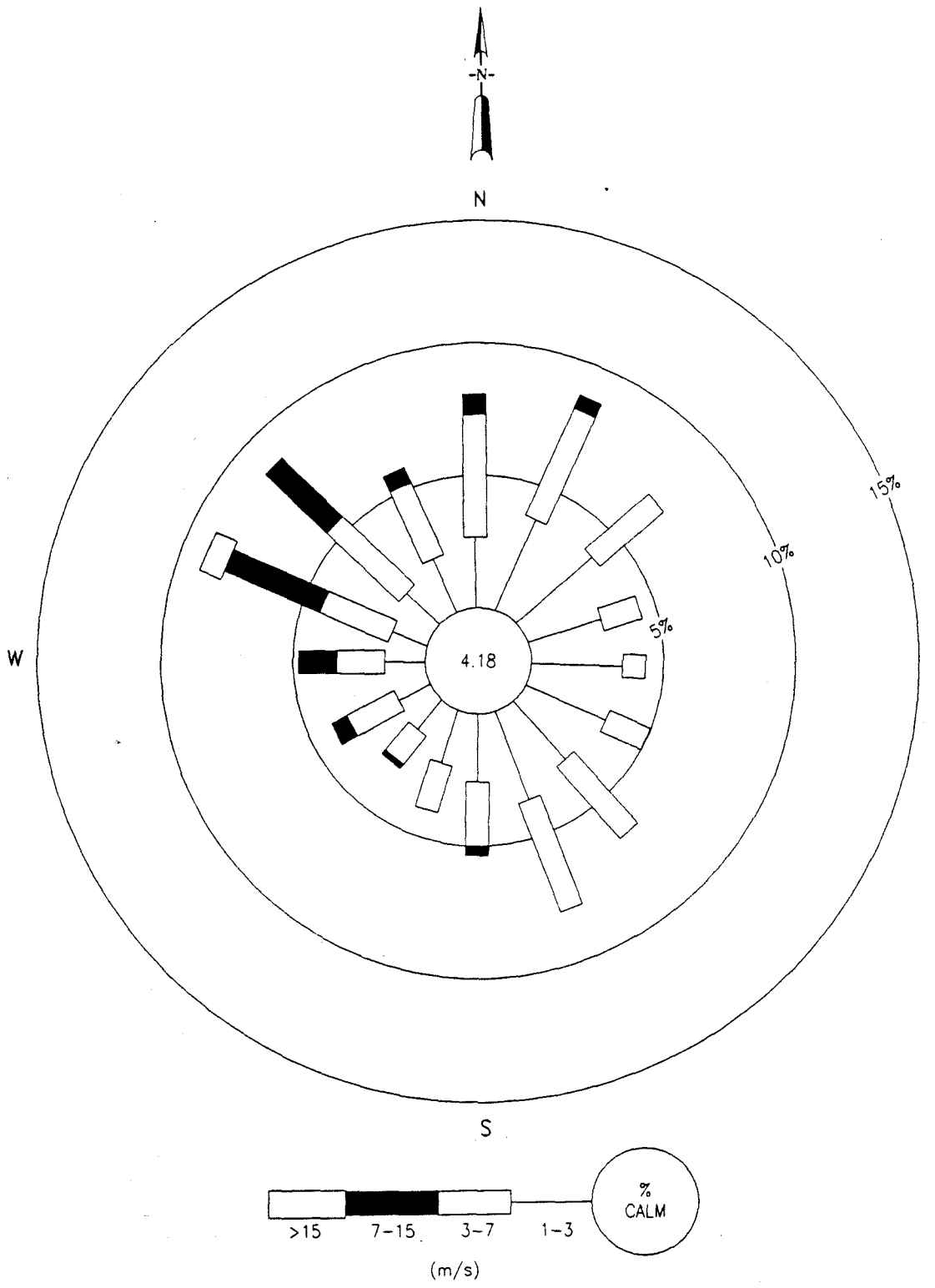
10 Meter Level

WIND SPEED CLASSES (KNOTS)

Wind Direction	<3.0	3.0 - <6.0	6.0 - <10.0	10.0 - <16.0	16.0 - <21.0	≥21.0	Class[a]	Total[b]
N	0.8	2.9	3.4	1.6	0.2	0.2	9.29	9.25
NNE	1.1	3.5	2.9	1.0	0.0	0.0	8.52	8.49
NE	1.1	3.3	1.6	0.3	0.0	0.0	6.31	6.29
ENE	1.0	2.3	0.8	0.1	0.0	0.0	4.20	4.19
E	1.4	3.0	0.7	0.0	0.0	0.0	5.06	5.04
ESE	0.9	2.7	1.9	0.1	0.0	0.0	5.60	5.58
SE	0.9	3.5	3.6	0.6	0.0	0.0	8.57	8.54
SSE	0.8	2.5	2.6	0.6	0.1	0.0	6.66	6.64
S	0.7	2.0	1.5	0.5	0.1	0.0	4.79	4.78
SSW	0.5	1.2	1.0	0.3	0.1	0.0	3.09	3.08
SW	0.3	1.2	1.2	0.4	0.1	0.0	3.29	3.28
WSW	0.4	1.1	1.2	1.0	0.4	0.3	4.25	4.24
W	0.5	1.1	1.1	1.6	1.1	1.5	6.89	6.87
WNW	0.5	1.3	1.5	3.0	1.8	1.6	9.59	9.56
NW	0.7	1.6	2.1	2.3	0.7	0.2	7.54	7.51
NNW	0.6	1.9	2.6	1.1	0.1	0.0	6.34	6.32
All	12.1	35.0	29.7	14.6	4.7	3.9.00	100.00	99.64

[a] Total percent for this stability class.
[b] Total percent relative to all stability classes (A through F).

Total number of invalid observations in this stability class = 18
Total number of valid observations in this stability class = 18,240
Joint data recovery rate = 99.9%



U.S. DEPARTMENT OF ENERGY Rocky Flats Plant Golden, Colorado	1990 ANNUAL WIND ROSE FOR THE ROCKY FLATS PLANT	FIGURE 2-10

R33176.MB021292

An extensive air monitoring network known as the Radioactive Ambient Air Monitoring Program (RAAMP) is maintained at the Plant in order to monitor particulate emissions from the Plant facilities. Historically, the particulate samplers located immediately east, southeast, and northeast of the 903 Pad site have shown the highest plutonium concentrations. This finding is corroborated by the results of soil surveys that indicate elevated plutonium concentrations to the east, particularly southeast of the site. However, the RAAMP has found ambient air samples for plutonium to be well within the DOE guidelines of 20.0 x 10^{-6} pCi/l established for the protection of human health (Rockwell International, 1987a).

Figure 2-11 shows the locations of the RAAMP ambient air samplers associated with OU5, and Table 2-9 presents the plutonium concentrations detected at those stations during 1990. Prior to January 1990, the biweekly filters from these onsite samplers and others were analyzed for total long-lived alpha activity only. If results exceeded the Rocky Flats Plant guideline of $10x10^{-6}$ pCi/l, specific plutonium analysis was performed. Data collected at ambient stations 10, 11, 13, 14, 23, 32, and 37 during 1986 through 1989 did not exceed this screening value; therefore, plutonium-specific analyses were not performed.

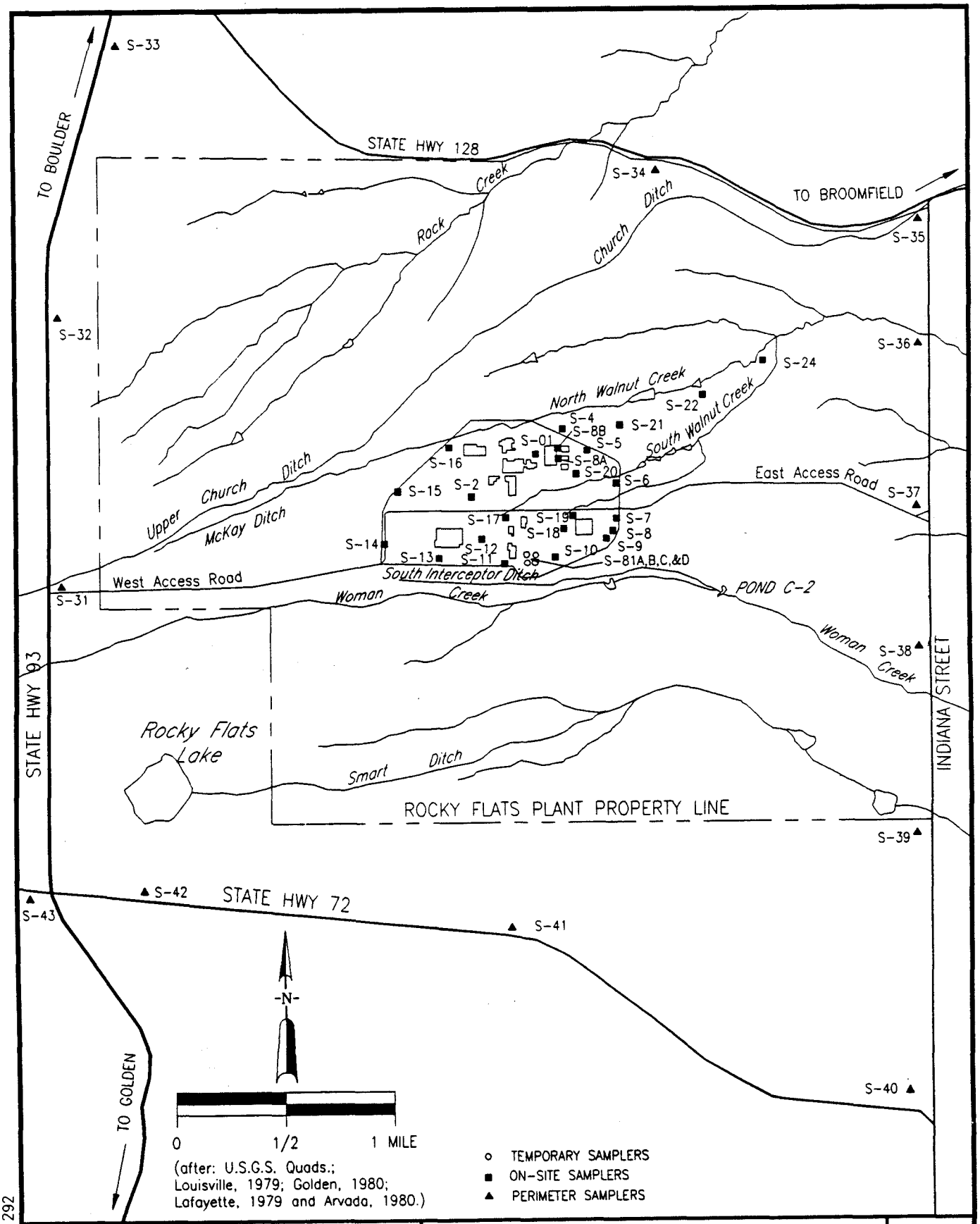
2.7 SITE CONCEPTUAL MODELS

A Site Conceptual Model of contaminant exposure pathways from the types of potential contaminant sources within OU5 is presented in this section. This Site Conceptual Model identifies all elements of an exposure pathway (contaminant source, primary release mechanisms, transport media, secondary release mechanisms, and exposure route) that were considered in the development of the Phase I Field Sampling Plan. After Phase I data is collected, IHSS-specific conceptual models can be developed and provide the basis for the BRA.

The primary purpose of the Site Conceptual Model is to aid in identifying exposure pathways by which populations may be exposed to contaminants from the IHSSs. The EPA defines an exposure pathway as "...a unique mechanism by which a population may be exposed to the chemicals at or originating from the site..." (EPA, 1989c). As shown in Figure 2-12, an exposure pathway must include a contaminant source, a release mechanism, a transport medium, an exposure route, and a receptor. An exposure pathway is not complete without each of these five components. The individual components of the exposure pathway are defined as follows:

- **Contaminant Source:** For the purposes of the OU5 conceptual model, the contaminant sources are waste and/or contaminated media that may be present at each IHSS. These sources include buried wastes and contaminated surface soils and sediments.

- **Release Mechanism:** Release mechanisms are physical and/or chemical processes by which contaminants are released from the source. The conceptual model for OU5 identifies mechanisms that release contaminants directly from the source and those that release contaminants from transport media (i.e., secondary release mechanisms). Numerous potential direct release mechanisms and secondary release mechanisms for OU5 are discussed in the conceptual model.



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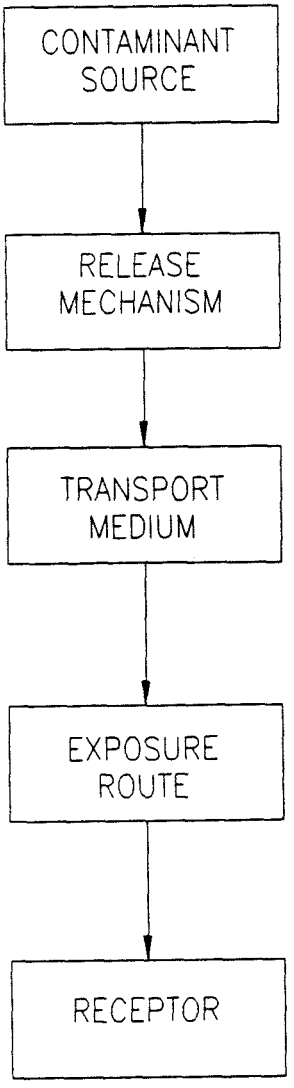
U.S. DEPARTMENT OF ENERGY Rocky Flats Plant Golden, Colorado	LOCATION OF ON-SITE AND PLANT PERIMETER AMBIENT AIR SAMPLERS	FIGURE 2-11

TABLE 2-9

PLUTONIUM CONCENTRATIONS IN AIR AT OU 5 DURING 1990

OU 5 PLUTONIUM-239 CONCENTRATIONS PRESENTED IN pCi/m³							
	1990						
	Station-10	Station-11	Station-13	Station-14	Station-23	Station-32	Station-37
JANUARY	0.000002	0.000006	0.000003	0.000001	0.000001	0.000000	0.000003
FEBRUARY	0.000007	0.000005	0.000001	0.000002	0.000003	0.000001	0.000002
MARCH	0.000016	0.000008	0.000004	0.000003	0.000005	0.000001	0.000003
APRIL	0.000004	0.000004	0.000005	0.000001	0.000002	0.000002	0.000002
MAY	0.000005	0.000006	0.000008	0.000001	0.000003	0.000002	0.000007
JUNE	0.000008	0.000004	0.000002	0.000002	0.000003	0.000002	0.000004
JULY	0.000007	0.000007	0.000008	0.000002	0.000003	0.000000	0.000002
AUGUST	0.000005	0.000007	0.000002	0.000003	0.000005	0.000000	0.000000
SEPTEMBER	0.000005	0.000007	0.000002	0.000002	0.000006	0.000003	0.000001
OCTOBER	0.000003	0.000001	0.000001	0.000004	0.000001	0.000002	0.000003
NOVEMBER	0.000004	0.000003	0.000007	0.000006	0.000002	0.000002	0.000002
DECEMBER	0.000002	0.000000	0.000001	0.000000	0.000001	0.000001	0.000005
Annual Ave.	0.000006	0.000005	0.000004	0.000002	0.000003	0.000001	0.000003
Max. Value	0.000016	0.000008	0.000008	0.000006	0.000006	0.000003	0.000007

pCi/m³ = picoCurie/cubic meter



U.S. DEPARTMENT OF ENERGY Rocky Flats Plant Golden, Colorado	COMPONENTS OF A COMPLETED EXPOSURE PATHWAY	FIGURE 2-12

R33159.PJMB021292

- **Transport Medium:** Transport media are the environmental media into which contaminants are released from the source and from which the contaminants are in turn released to a receptor (or to another transport medium by a secondary release mechanism). Potential transport media for OU5 include, air, soils, sediment, surface water, groundwater, and biota (both flora and fauna).

- **Exposure Route:** Exposure routes are avenues through which contaminants are physiologically incorporated by a receptor. Exposure routes for receptors at OU5 are inhalation, ingestion, dermal contact, and external exposure to radiation from radionuclides.

- **Receptor:** Receptors are human or environmental populations that are affected by the contamination released from a site. Environmental receptors include biota (both flora and fauna) indigenous to the OU5 environs.

2.7.1 Contaminant Source Descriptions

2.7.1.1 Original Landfill (IHSS 115)

Most of the limited data available for IHSS 115 suggests the possibility of a wide range of chemicals in the refuse in the landfill. In addition, depleted uranium is likely present in the landfill, and it is possible plutonium contaminated materials are present. Several radioactive anomalies have been identified at the perimeter of the landfill where it slopes down to the SID. Nonradioactive contaminants associated with the landfill likely include, volatile organics, semi-volatile organics and inorganic ions. The landfill is currently covered with a thin clay cap of presumably clean fill. However, there are several locations where the cover has slumped downslope and refuse is exposed.

2.7.1.2 Incinerator, Ash Pits, and Concrete Wash Pad (IHSS 133)

The incinerator (IHSS 133.5) was used to burn general plant wastes from the 1950s to 1968. Depleted uranium is also believed to have been burned in the incinerator (Rockwell 1988). Ashes from the incinerator were placed into the Ash pits (IHSS 133.1 through 133.4) or were pushed over the side of the hill into the Woman Creek drainage and/or onto the Concrete Wash Pad (IHSS 133.6). After the incinerator was closed in 1968, the ash pits were covered with fill. The Concrete Wash Pad appears to have been used to dispose of waste concrete and truck washdown water from construction activities at Rocky Flats Plant. Results from sampling a monitoring well downgradient of the Ash Pits indicate elevated levels of metal and radionuclides. However, due to the limited characterization of the site, it is possible that other contaminants are present at this location.

2.7.1.3 Detention Ponds C-1 and C-2 (IHSS 142)

Detention Ponds C-1 and C-2 (IHSSs 142.10 and 142.11) along the Woman Creek drainage and the SID are used primarily to capture and control surface water runoff. Pond C-1 receives water from Woman Creek, while Pond C-2 receives water from the SID, which in turn collects surface water runoff from the southern part of the production facilities (see Subsection 2.4). Historically, water and sediment samples from these ponds have occasionally contained low concentrations of radionuclides, VOCs, base neutral compounds, pesticides and metals.

2.7.1.4 Surface Disturbances (IHSS 209)

The surface disturbances are thought to be old borrow pits to provide fill for other parts of the Rocky Flats Plant. Although there is no information that indicates that hazardous wastes have been disposed of in these locations, it is possible such activities occurred in the past.

2.7.1.5 Area South of OU5 to the Property Boundary

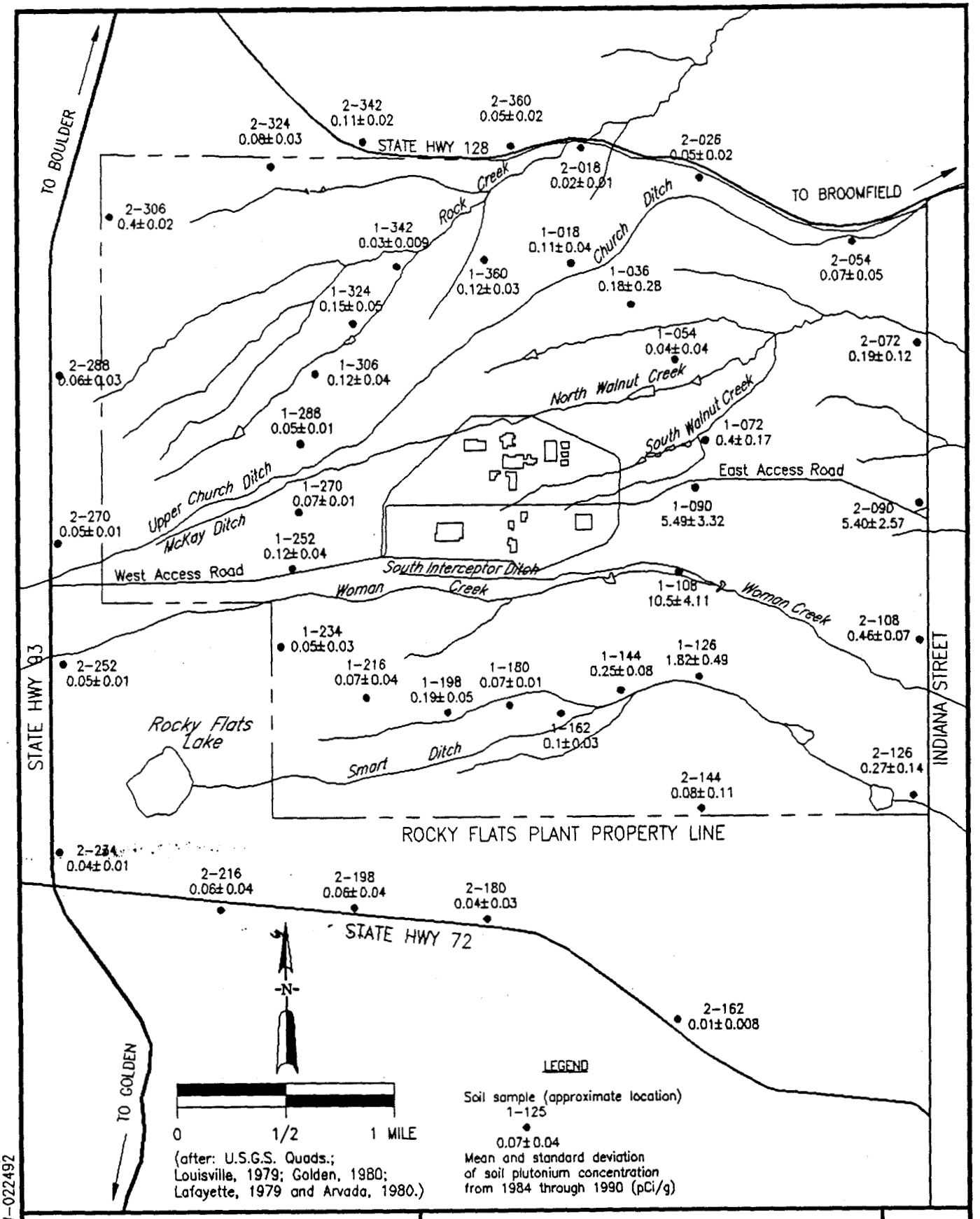
The area south of OU5 to the property boundary was deliberately excluded from the list of OUs and IHSSs in the IAG due to lack of known sources of contamination. Surface soil sampling for plutonium was previously conducted in this area. There were only two sampling locations with levels slightly in excess of the CDH Construction Standard of 0.9 pCi/g (Figure 2-13). Surface soil sampling for plutonium and other radionuclides may be performed in this area pending further data evaluation. This is discussed in Subsection 7.2.4.1. Until more detailed site characterization information is available, it is assumed that no significant exposure to contaminants occurs via this area.

2.7.2 Primary Release Mechanisms and Transport Media

There are a number of mechanisms by which contaminants are released into environmental media. As shown in Figures 2-14 and 2-15, all primary release mechanisms apply to contaminated surface soils and sediments fugitive dust wind erosion; surface runoff; volatilization; infiltration/percolation; biotic uptake; and tracking. Volatilization, infiltration/percolation and tracking also apply to buried wastes.

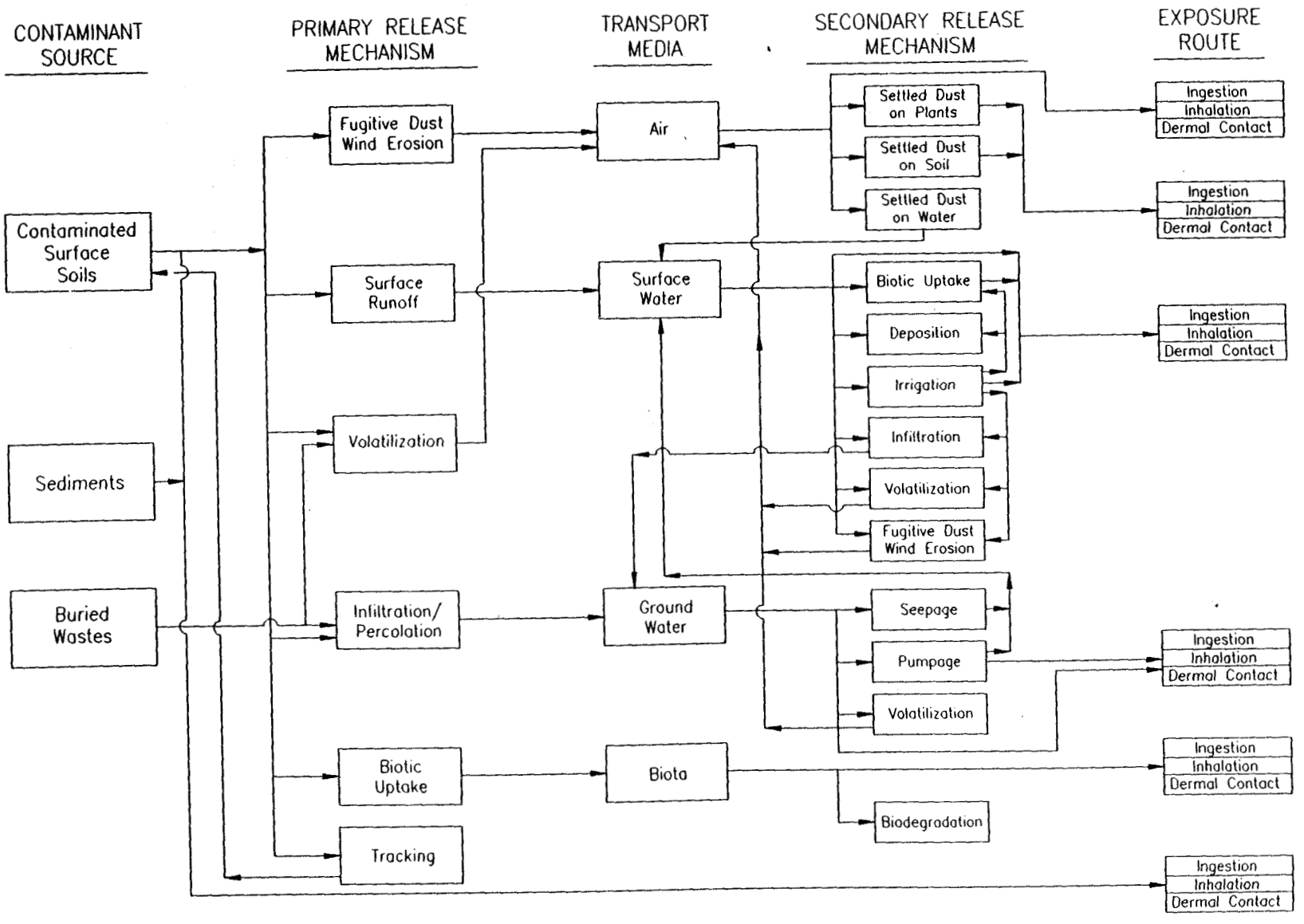
Once contaminants are released from a source, they will enter an environmental medium where contaminants will be transported either to a point of exposure or be released (secondary release mechanism) to another environmental medium (and subsequently transported to a point of exposure). The transport medium a contaminant enters is determined by the primary release mechanism. For example, volatilization or fugitive dust wind erosion will result in contaminant release to the air. Surface runoff will transport contaminants to surface water while infiltration/percolation results in contaminant transport to groundwater. Contaminants entering biota is simply due to biotic uptake.

The physical and chemical properties of a contaminant determine the tendency of a contaminant to be



R33182.MBCW-022492

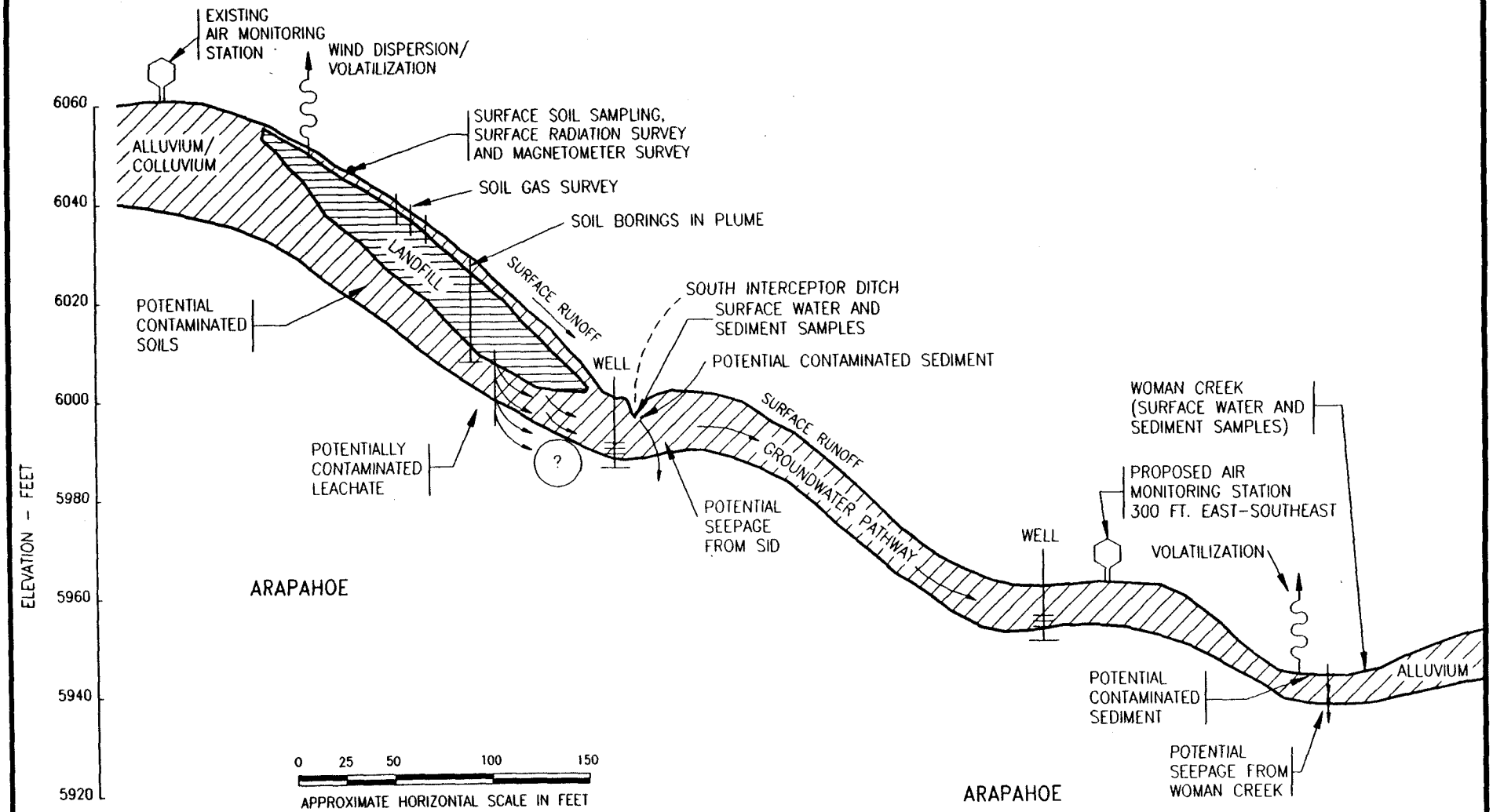
U.S. DEPARTMENT OF ENERGY Rocky Flats Plant Golden, Colorado	SOIL SAMPLING LOCATIONS	FIGURE 2-13



U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden, Colorado

RISK ASSESSMENT CONCEPTUAL MODEL

FIGURE
2-14



U.S. DEPARTMENT OF ENERGY Rocky Flats Plant Golden, Colorado	SAMPLING PROGRAM AND PATHWAY ANALYSES ORIGINAL LANDFILL	FIGURE 2-15

released from a source, and the fate and mobility in a transport medium once released. The following subsections provide a brief summary of these contaminant properties.

2.7.2.1 Organic Contaminants

Table 2-10 presents some of the relevant chemical/physical parameters that control the environmental fate and transport of representative organic chemicals. Because two IHSSs at OU5 accepted a wide range of materials, further investigation may identify additional organic chemicals not present on this list.

TCL Volatiles

TCL volatiles are generally more mobile in the environment than other chemicals (Table 2-10). Volatiles are generally characterized by relatively high water solubility (greater than 100 mg/l) and volatility (vapor pressures greater than 1.0 mm Hg and Henry's Law Constants greater than 0.1). Volatiles can be expected to migrate through soils, sediment and groundwater in both liquid and vapor phase and to be transported in surface water and groundwater as neutral solutes. This is denoted by retardation factors (Rd) between 1 and 50 (Chemical migration velocity = water migration velocity/Rd). The Henry's Constants of volatiles suggest a tendency to volatilize from aqueous systems (including soil/water) to the atmosphere and, therefore, are unlikely to be detected in sediments and soils.

TCL Semivolatiles and Pesticides/PCBs

Semivolatile compounds and pesticides/PCBs typically are much less mobile than volatile compounds (Table 2-10). The retardation factors for semivolatiles and pesticides/PCBs range from approximately 100 to over 180,000,000 with the exception of the phenolic compounds. Phenols are relatively mobile because of their high water solubility. Semivolatiles and pesticides/PCBs exhibit low to negligible volatility as indicated by the low vapor pressures and Henry's Constants. This suggests a low propensity for volatilization of these compounds to the atmosphere from soil and surface water.

2.7.2.2 Radionuclides and Metals

Table 2-11 summarizes the distribution coefficients for radionuclides and inorganic elements. A distribution coefficient (K_d) is the ratio of the concentration of a compound in the solid phase to its concentration in solution at equilibrium. The distribution coefficients are considered empirical and are strongly influenced by the environmental conditions existing where the experiments are performed. Inorganic compounds differ from organic compounds in that they can be present in solution in a number of different forms or species. The form of an inorganic chemical is important in evaluating that chemical's mobility. Each species or complex may have different solubilities and the concentration of each can be related to several factors including pH and oxidation/reduction potential (E_h).

TABLE 2-10

CHEMICAL/PHYSICAL PARAMETERS AFFECTING ENVIRONMENTAL FATE AND TRANSPORT FOR ORGANICS

Chemical	Molecular Weight (g/mole)	Specific Gravity (g/cc)	Vapor Pressure (mmHg)	Henry's Constant (Dimensionless)	Water Solubility (mg/l)	Log Kow (c/c)	Log Koc (ml/g)	Saturated Zone Rd	Mobility Index MI	Env. Mobility
TCL VOLATILE ORGANICS										
Ketones & Aldehydes										
Acetone	55.1	0.1	270.00	0.013	60000.0	-0.24	-0.43	1.0	8	Extremely Mobile
Monocyclic Aromatics										
Benzene	78.1	0.9	76.00	0.182	1780.0	2.13	1.81	6.8	3	Very Mobile
Toluene	92.1	0.9	22.00	0.214	515.0	2.79	2.48	28.0	2	Very Mobile
Ethyl Benzene	106.2	0.9	7	0.266	152.0	3.34	3.04	100.0	-0	Slightly Mobile
Xylene	106.2	0.9	10	0.380	152.0	3.13	2.11	12.6	1	Very Mobile
Chlorinated Aliphatics										
Carbon Tetrachloride	153.8	1.6	90.00	0.960	785.0	2.96	2.64	40.5	2	Very Mobile
Trichloroethene	131.4	1.5	60.00	0.390	1100.0	2.42	2.10	12.3	3	Very Mobile
Chloroform	119.4	1.5	160.00	0.130	8000.0	1.97	1.64	4.9	4	Very Mobile
1,1,1,2-Trichloroethane	167.9	1.6	5.00	0.016	2900.0	2.39	2.07	11.6	2	Very Mobile
SEMIVOLATILE ORGANICS										
Acid Extractables (Phenolics)										
Phenol	94.1	1.1	0.20	1.2E-04	8200.0	1.46	1.15	2.3	2	Very Mobile
Pentachlorophenol	266.4	2.0	1.1E-0	1.1E-04	14.0	5.18	4.72	4771.3	-8	Immobile
2,4-Dinitrophenol	184.1	1.7	1.5E-05	2.7E-08	5600.0	1.54	1.22	2.5	-2	Slightly Immobile
2,4,6-Trichlorophenol	197.5	1.5	0.012	1.6E-04	800.0	3.61	3.30	181.0	-2	Slightly Immobile
Base-Neutral Extractables										
Bis(2-ethylhexyl)phthalate	391.1	1.0	2.7E-07	4.4E-06	1.3	9.61	9.30	1.8E+08	-16	Very Immobile
Chrysene	228.2	1.3	1.0E-11	6.9E-08	0.0	5.61	5.30	1.8E+04	-19	Very Immobile
1,2,4-Trichlorobenzene	181.5	1.5	0.29	9.6E-02	30	4.28	3.96	8.3E+02	-3	Slightly Immobile
1,3-Dichlorobenzene	147.0	1.3	2.28	1.5E-01	123	4.28	3.96	8.3E+02	-2	Slightly Immobile
Naphthalene	128.2	1.0	0.087	1.9E-02	31.7	3.29	2.97	8.6E+01	-3	Slightly Immobile
Benzo(a)pyrene	252.0	1.4	5.6E-09	2.0E-05	3.8E-03	6.06	6.74	5.0E+05	-17	Very Immobile

TABLE 2-10

CHEMICAL/PHYSICAL PARAMETERS AFFECTING ENVIRONMENTAL FATE AND TRANSPORT FOR INORGANICS (Concluded)

Chemical	Molecular Weight (g/mole)	Specific Gravity (g/cc)	Vapor Pressure (mmHg)	Henry's Constant (Dimensionless)	Water Solubility (mg/l)	Log Kow (c/c)	Log Koc (ml/g)	Saturated Zone Rd	Mobility Index MI	Env. Mobility
PCBs AND PESTICIDES										
PCBs										
PCB-1248	299.5	1.4	4.9E-04	1.5E-01	0.054	5.76	5.44	24931.0	-10	Immobile
PCB-1254	328.4	1.5	7.7E-05	4.6E-02	0.0	6.03	5.72	47233.7	-11	Very Immobile
PCB-1260	375.7	1.6	4.1E-05	2.8E-01	0.0	7.15	6.82	594625.1	-14	Very Immobile
Chlorinated Pesticides										
Dieldrin	381.0	1.8	1.8E-07	1.9E-05	0.2	3.54	3.23	153.8	-11	Very Immobile
DDT	375.7	1.6	1.9E-07	7.1E-04	5.5E-03	6.91	6.59	350141.6	-16	Very Immobile
Heptachlor	375.0	1.6	3.0E-04	3.4E-02	0.18	4.4	4.1	1081.0	-8	Immobile
Lindane	291.0	1.6	2.5E-05	2.5E-04	1.6	3.9	3.6	343.0	-8	Immobile
Chlordane	409.8	1.6	1.0E-05	4.0E-03	0.056	5.5	5.1	12601.0	-11	Very Immobile
Toxaphene	414.0	1.6	0.3	1.4E+01	0.5	3.3	3.0	87.8	-4	

Source: EG&G, 1990e

TABLE 2-11

DISTRIBUTION COEFFICIENTS FOR RADIONUCLIDES AND METALS ELEMENTS

Chemical	Representative Value[1]	Summary Range	
		Low	Maximum
Radionuclide			
Americium-241	700	0[4]	47,230[1]
Bismuth-214	200		
Cadmium-109	6.5	1.26[1]	50[3]
Cesium-143	850	3.0[4]	300,000[2]
Cesium-137	1,000	1.3[4]	52,000[1]
Cobalt-60	45	0.2[1]	23,624[4]
Lead-212-Bismuth	900	4.5[1]	7,640[1]
Plutonium-238	4,500	0.4[4]	8.7E7[4]
Potassium-40	5.5	2.0[1]	9.0[1]
Radium-288	450	200[1]	467[4]
Strontium-90	35	0.15[1]	4,300[4]
Thorium-228	1,500	5[4]	1E6[4]
Uranium-234	1,500	0[1]	4,400[1]

[1]U.S. Department of Energy, 1984, A Review and Analysis of Parameters for Assessing Transport of Environmental Released Radionuclides through Agriculture.
[2]U.S. Department of Energy, 1980, Determination of Distribution Coefficients for Plutonium, range of results for a variety of sediments in the Enewetak Lagoon using Lab and Field experiments; Transuranic Elements in the Environment, Technical Information Center.
[3]Couphtrey, P.J. and Thorne, M.C., 1983, Radionuclide Distribution and Transport in Terrestrial and Aquatic Ecosystems, A Compendium of Data.
[4]ACS Symposium Series, 1979, Radioactive Waste in Geologic Storage (Abyssal Red Clay)
Conc = 1E3–1E8 mg/atom/ml in 0.68N NaCl Soin Distributed Coefficient for CS pH2.7-8.0 Figure 1; for Cd pH 5.3 Figure 3; for Sr Phy.1-73; for Ba pH 2.6-8.3 Figure 2; for Ce pH 5.8-8.0 Figure 4.

TABLE 2-11

DISTRIBUTION COEFFICIENTS FOR RADIONUCLIDES AND METALS ELEMENTS (Continued)

Chemical	Representative Value[1]	Summary Range	
		Low	Maximum
Metals			
Aluminum	1,500	0[4]	122.8[4]
Antimony	45	1.0[5]	18[5]
Arsenic	200	5[4]	30,000[4]
Barium	60		
Beryllium	650		
Boron	3	1.26[1]	50[4]
Cadmium	6.5		
Chromium	850	0.2[1]	3,800[1]
Cobalt	45	1.4[1]	333[1]
Copper	35	4.5[1]	7,640[1]
Lead	900	0.2[1]	10,000[1]
Manganese	65	30[7]	82,800[7]

[1]U.S. Department of Energy, 1984, A Review and Analysis of Parameters for Assessing Transport of Environmental Released Radionuclides through Agriculture.
[4]Radionuclide Interactions with Soil and Rock Media Volume 1: Processes Influencing Radionuclide Mobility and Retention, Element Chemistry and Geochemistry, Conclusions and Evaluation, Battelle Pacific Northwest Labs, Richland, WA EPA No. 6078-007, August 1978.
[5]Dragun, 1988, The Soil Chemistry of Hazardous Materials, Dragun, 1988, Ranges of Kd for various Elements in Soils and Clays, Table 4.2, pg 158.

TABLE 2-11

DISTRIBUTION COEFFICIENTS FOR RADIONUCLIDES AND METALS ELEMENTS (Continued)

Chemical	Representative Value[1]	Summary Range	
		Low	Maximum
Mercury	10	0.37[1]	400[1]
Molybdenum	20	200[7]	300,000[7]
Nickel	150		
Selenium	300		
Silicon	30	10[1]	1,000[1]
Silver	45		
Thallium	1,500		
Titanium	1,000		
Vanadium	1,000		
Zinc	40	0.1[1]	8,000[1]

[1]U.S. Department of Energy, 1984, A Review and Analysis of Parameters for Assessing Transport of Environmental Released Radionuclides through Agriculture.
[7]EPRI, 1984, Chemical Attenuation Rates, Coefficients, and Constants in Leachate Migration Volume I. A Critical Review. Battelle Pacific Northwest Laboratories, Richland, WA. EPRI EA-3356, Kd for Ba in River Sediments; Kd for Me= pH=6.6 with Bentonite, Kd-82800 Ph-5.95 for Iron Oxide; Kd=200 for Ni in seawater with Clay pH=8; with Mn Oxide Kd=300,000 pH=8.

Radionuclides

The limited data available for OU5 indicates that depleted uranium is a buried waste at two IHSSs, and plutonium contaminated wastes may also be present. Americium is also likely to occur either from in situ ingrowth from the plutonium or from direct disposal of americium contaminated material.The following discussions focus on characteristics of uranium and plutonium which may affect their fate and mobility in the environment (Table 2-11). Numerous studies of uranium and plutonium fate and mobility are incorporated by reference into the discussions. Much less information is available on the nature of americium in the environment. Americium has essentially the same characteristics in the environment as plutonium and is considered insoluble under typical environmental conditions.

Uranium

Uranium has 14 isotopes that decay to other elements at half-lives of minutes to 4.5 billion years. Natural uranium is comprised mainly of U-238 (99.27%) with some U-235 (0.72%) and minor amounts of U-234 (0.0057%) (Table 2-12). Enriched uranium contains a higher percentage of the fissile U-235 isotope. Depleted uranium, a potential contaminant at OU5, contains less U-235 and U-234, and more U-238. Uranium-234 is a daughter product of U-238.

Thermodynamic data (Langmuir 1978) indicates that most uranium in natural waters exists in the U(IV) or U(VI) oxidation state. Uranium in both oxidation states exhibits a strong affinity to complex with available anions in natural waters as either uranous (U^{4+}) or uranyl (UO_2^{+2}) ion. Because U(IV) species tend to precipitate as insoluble uraninite or coffinite (Langmuir, 1978), uranyl ion is the mobile species for most oxidizing groundwaters. More importantly, UO_2^{+2} is mobile over a relatively wide pH range. Depending on the ligands available and the pH, uranyl ion will form soluble complexes in oxidizing waters. Thus, uranyl will be soluble and hence mobile in most oxidizing groundwaters that contain common ligands. Oxidizing conditions probably exist in all alluvial/colluvial materials and extend at least into shallow bedrock as indicated by iron-oxidation staining in numerous drill logs. Therefore, uranium migration via surface water and groundwater is likely given adequate leaching, and, therefore, uranium should be analyzed when characterizing these transport media.

Uranium has a lower K_d than plutonium or americium (Table 2-11). However, under reducing conditions (such as high-organic, fine-grained, bed sediments deposited in the deeper layers of sediments) uranium is immobilized and becomes part of the sediments. Yang and Edwards (1984) documented the fate and transport of uranium and its daughter product, radium-226, in dissolved form, and in both suspended and bed sediments, from above the Schwartzwalder (uranium) Mine adjacent to Ralston Creek several miles southwest of the Rocky Flats Plant. Uranium is present in dissolved and solid phases. Concentrations range from 4 μg/l dissolved in the creek water above the mine to 100 μg/l in Ralston reservoir below the mine. Uranium occurred as both a discrete mineral and as partially entrapped colloidal iron and manganese coatings on suspended and bed sediments.

TABLE 2-12

ISOTOPIC COMPOSITION OF ROCKY FLATS URANIUM

	Relative Weight (%)		Relative Activity* (pCi/μg)	
Isotopic	**Natural Uranium**	**Depleted Uranium**	**Natural Uranium**	**Depleted Uranium**
U-232	0	Trace	0	Trace
U-233	0	Trace	0	Trace
U-234	0.0057	0.002	0.35	.124
U-235	0.72	0.3	0.015	.006
U-236	0	0.0003	0	.0002
U-238	99.27	99.7	0.33	.332

* Relative activity is obtained by multiplying the percentage by weight by the specific activity. pCi/μg = picoCurie/microgram.

Plutonium

There are 15 known isotopes of plutonium that decay into other elements at half-lives ranging from hours to 387,000 years (Ames and Rai, 1978). At the Rocky Flats Plant, plutonium exists primarily as Pu-239 and Pu-240 (Table 2-13).

Plutonium specification in the environment is heavily influenced by hydrogen ion concentration (pH) and oxidation-reduction capacity (Eh). Typical environmental conditions are pH in the range of 5 to 8 and a positive Eh (greater than 0.05 volts) (Brownlow, 1979). Under these conditions, plutonium species will most likely be found in the following order of occurrence: $Pu^{+4} > PuO_2 > Pu^{+3} > PuO^{+1}$ (Ames and Rai, 1978).

As shown above, the most probable species in the environment is the plus 4 valence (oxidation state) species, which will exist either as plutonium dioxide (PuO_2) or as a solid hydroxide $Pu(OH)_4$ (Brookins, 1984; Dragun, 1988). The assertion is based on the assumption that the pH of the environmental system is near neutral and that the system is in an oxidative state (Eh >0).

Plutonium shows a very strong tendency to adsorb to clays, metal dioxides, and organic matter in soils, and thus has a very low migration potential in the environment (CSU, 1974; Brookins, 1984). The distribution coefficient (K_d), for plutonium is 10^3- 10^5 (Allard and Rydberg, 1983), meaning that the ratio of plutonium bound to soil to plutonium dissolved in water would be expected to vary from 1000:1 to 100,000:1. The EPA (1990b) gives a K_d of 2 x 10^3 for plutonium. At a minimum, analysis of surface water samples should include total plutonium because plutonium may be present in the suspended fraction. Although plutonium is not expected to migrate readily in groundwater, its common occurrence in soil and surface water, and the lack of initial data suggest the Phase I RFI/RI include plutonium analysis for groundwater samples.

Metals and Major Ions

In general, the solubility of metals and major ions in natural water situations are very sensitive to pH and Eh conditions as are the radionuclides. Based on their physical properties (Table 2-11), they can form complexes and potentially move relatively rapidly within the hydrosphere. There is also a tendency for the ions to be incorporated into new minerals, to be adsorbed on to mineral surfaces, ion exchange or to be coprecipitated. Because initial data on source characterization is limited, the Phase I RFI/RI should include metals analysis in waste, soils, and water.

TABLE 2-13

ISOTOPIC COMPOSITION OF ROCKY FLATS PLUTONIUM

Isotopic	Relative Weight (percent)	Specific Alpha Activity (Curies/gram)	Specific Beta Activity (Curies/gram)	Relative[a] Activity (Curies/gram)
Pu-238	0.01	17.1	--	0.00171
Pu-239	93.79	0.0622	--	0.056834
Pu-240	5.80	0.228	--	0.01322
Pu-241	0.36	—	103.5	0.37260
Pu-242	0.03	0.00393	--	1.18×10^{-6}
Am-241	--[b]	3.42	--	--

Source: Rockwell, 1985b.

[a]Relative activity is obtained by multiplying the percent by weight by the specific activity.
Total activity for the plutonium isotopes is:
Alpha 0.0732 curries/gram
Alpha plus Beta 0.446 curies/gram

[b]Am-241 daughter from decay of Pu-241.

2.7.3 Secondary Release Mechanisms and Exposure Routes

As shown in Figure 2-14, there are numerous secondary release mechanisms and exposure routes for contaminants that may be released from OU5 sources. This figure shows all potential pathways; however, the actual pathways of significance will be determined during the risk assessment.

2.7.4 Receptors

The point of exposure includes the source material or any point within a transport media that is contaminated. Whether the human receptor is a resident or visitor there is the potential for direct exposure through multiple pathways. Biota may also be present and be potential receptors. The potential for exposure and the magnitude of risk will be assessed during the risk assessment.

2.7.5 Exposure Pathway Characterization

The elements of the Site Conceptual Model described above are cross referenced to the FSP for characterization details in Table 2-14 through 2-17 for each IHSS. Site sampling based upon the site conceptual model will improve the characterization of contaminant pathways for each IHSS. As additional information is obtained, the overall model and specific portion of the model may be refined or expanded to address the issues of concern.

TABLE 2-14

OU5 PHASE I SITE CHARACTERIZATION OF EXPOSURE PATHWAYS:
ORIGINAL LANDFILL (IHSS 115)

Contaminant Source	Primary Release Mechanism	Transport Media	Secondary Release Mechanism
Buried Waste Table 7-1 (1,2,3,4,5,8,11,12,13,14, 15) Contaminated Surface Soil Table 7-1, (2,5,7) Table 7-4	Fugitive Dust Wind Erosion Table 7-1 (6) Section 7.2.5 Air Sampling Table 7-1, (6) Surface Runoff Table 7-1, (10) Table 7-4 (2-4) Volatilization Table 7-1, (5,10) Infiltration Percolation Table 7-1, (3,4,8,11,12,13) Biotic Uptake Section 9.0 Tracking Section 9.0	Air Section 7.2.5 Surface Water Table 7-1, (10,14,15) Table 7-4 Table 7-4, (2-4) Groundwater Table 7-1, (3,4,8,11,12,13) Biota Section 9	Settled Dust on Plants – Phase II Settled Dust on Soil Section 7.2.5 Table 7-1, (7) Table 7-4, (2,3,4) Settled Dust on Water Table 7-1, (10) Table 7-4, (2,3,4) Biotic Uptake Section 9 Deposition Table 7-1, (10) Table 7-4, (2-4) Irrigation OU 3 Work Plan Infiltration Table 7-1, (8,9,12,13) Table 7-4, (2-4) Volatilization Table 7-1, (7); 7-4, (2-4) Fugitive Dust Wind Erosion Table 7-1, (10); 7-4, (2-4) Seepage Table 7-1 (12,13) Pumpage Table 7-1; OU 3 Work Plan Volatilization Table 7-1, (7,13), 7-4, (2-4) Biodegradation-Phase II

TABLE 2-15

OU5 PHASE I SITE CHARACTERIZATION OF EXPOSURE PATHWAYS:
INCINERATOR, ASH PITS AND CONCRETE WASH PAD (IHSS 133)

Contaminant Source	Primary Release Mechanism	Transport Media	Secondary Release Mechanism
Buried Waste Table 7-2 (1,2,3,4,5,6,7) Contaminated Surface Soil Table 7-2, (2,3,4,5) Table 7-4 (1)	Fugitive Dust Wind Erosion Table 7-2 (5) Section 7.2.5 Air Sampling Table 7-2, (5) Surface Runoff Table 7-2, (5) Table 7-4 (1) Volatilization Table 7-1, (15) Infiltration Percolation Table 7-2, (3,4,6,7) Biotic Uptake Section 9.0 Tracking Section 9.0	Air Section 7.2.5 Surface Water Table 7-2, (5) Table 7-4, (1) Groundwater Table 7-2, (7) Biota Section 9	Settled Dust on Plants – Phase II Settled Dust on Soil Section 7.2.5 Table 7-2, (5) Table 7-4, (1) Settled Dust on Water Table 7-2, (5) Table 7-4, (1) Biotic Uptake Section 9 Deposition Table 7-2, (5) Table 7-4, (1) Irrigation OU 3 Work Plan Infiltration Table 7-2, (3-7) Volatilization Table 7-2, (5), 7-4, (1) Fugitive Dust Wind Erosion Table 7-2, (5), 7-4, (1) Sec. 7.2.5 Seepage Table 7-2, (6,7) Pumpage OU 3 Work Plan Volatilization Table 7-2, (5); 7-4, (1) Biodegradation-Phase II

TABLE 2-16

OU5 PHASE I SITE CHARACTERIZATION OF EXPOSURE PATHWAYS:
C-SERIES DETENTION PONDS (IHSS 142.10-11)

Contaminant Source	Primary Release Mechanism	Transport Media	Secondary Release Mechanism
Buried Waste Table 7-3, (1,2,3,4,5)	Fugitive Dust Wind Erosion Section 7.2.5	Air Section 7.2.5	Settled Dust on Plants – Phase II
Contaminated Surface Soil Table 7-3, (1,2,4,5)	Air Sampling Table 7-3, (2,4,5)	Surface Water Table 7-3, (2)	Settled Dust on Soil Section 7.2.5 Table 7-3, (4,5)
	Surface Runoff Table 7-3, (2,3,4,5) Table 7-4, (1-6)	Groundwater Table 7-3, (6)	Settled Dust on Water Table 7-3, (2,3,4,5)
	Volatilization Table 7-3	Biota Section 9	Biotic Uptake Section 9
	Infiltration Percolation Table 7-3		Deposition Table 7-3, (2,3,4,5)
	Biotic Uptake Section 9.0		Irrigation OU 3 Work Plan
	Tracking Section 9.0		Infiltration Table 7-3, (6)
			Volatilization Table 7-3
			Fugitive Dust Wind Erosion Table 7-3 Sec. 7.2.5
			Seepage, Table 7-3 Phase II
			Pumpage Table 7-6; OU 3 Work Plan
			Biodegradation-Phase II

TITLE: Applicable or Relevant and Appropriate Requirements

Approved By: [signature] 2/24/92
Name (Date)

3.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

This section provides a preliminary identification of chemical-specific Applicable or Relevant and Appropriate Requirements (ARARs) for groundwater, surface water, and soils at Operable Unit 5 so that appropriate analytical detection limits are used during the RCRA Facility Investigation/Remedial Investigation. Use of appropriate detection limits is necessary to allow evaluation of compliance with ARARs in the Corrective Measures Study/Feasibility Study (CMS/FS) report. As described in Subsection 3.2, evaluation and establishment of location-specific ARARs are a part of the RI process and will be addressed in the RFI/RI Report. Chemical-specific ARARs will be established in the RFI/RI Report. Identification of action-specific ARARs and remediation goals is a part of the feasibility study process and will be addressed in the CMS/FS Report.

3.1 THE ARAR BASIS

The basis for ARARs is cited in Section 121(d) of Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), which requires that Fund-financed, enforcement, and federal facility remedial actions comply with all applicable or relevant and appropriate promulgated federal and state environmental or facility siting laws. For the purposes of identification and notification of promulgated state standards, the term "promulgated" means that the standards are of general applicability and are legally enforceable. (National Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) 300.400(g)(4).)

Health-based, chemical-specific ARARs pertinent to groundwater, surface water, and soils (environmental media addressed by this work plan) have been identified for the Environmental Protection Agency's (EPA) Contract Laboratory Program (CLP), target compound list (TCL) for organic, and target analyte list (TAL) for inorganic compounds, as well as radionuclides and conventional pollutants. The chemical-specific ARARs are primarily derived from federal and state health and environmental statutes and regulations. As discussed below, in some instances, these standards are classified as terms "to be considered" (TBC). A summary of potential chemical-specific ARARs/TBCs for possible contaminants in Operable Unit (OU) 5 groundwater is presented in Table 3-1. Similarly, potential ARARs/TBCs for OU5 surface water are summarized in Tables 3-2 and 3-3.

One medium for which chemical-specific ARARs do not currently exist is soils. As the remedial investigation proceeds, information will become available from the baseline risk assessment that will allow a determination of acceptable contaminant concentrations in soils to ensure environmental "protectiveness." This is discussed further in Subsection 3.5.

TITLE: Data Needs and Data Quality Objectives

Approved By:
Name (Date) 2/29/92

4.0 DATA NEEDS AND DATA QUALITY OBJECTIVES

The primary objective of a RCRA Facility Investigation (RFI)/Remedial Investigation (RI) is to collect the data necessary to determine the nature, distribution, and migration pathways of contaminants. This information is used to support a baseline risk assessment and environmental assessment. These assessments determine the need for remediation and are used to evaluate remedial alternatives. Five general goals of an RFI/RI (U.S. EPA 1988a) are to

- Characterize site physical features
- Define contaminant sources
- Determine the nature and extent of contamination
- Describe contaminant fate and transport
- Provide a baseline risk assessment

Data quality objectives (DQOs) are qualitative and quantitative statements that describe the quality and quantity of data required by the RFI/RI (U.S. EPA 1987a). The DQO process is divided into three stages:

- Stage 1 - Identify decision types
- Stage 2 - Identify data uses/needs
- Stage 3 - Design data collection program

Through application of the DQO process, site-specific RFI/RI goals are established and data needs are identified for achieving those goals. This section of the RFI/RI work plan proceeds through the DQO process.

4.1 STAGE 1 - IDENTIFY DECISION TYPES

4.1.1 Identify and Involve Data Users

Data users are the decision makers and the primary and secondary data users. The decision makers for OU5 are the management and regulatory personnel for EG&G, the Department of Energy (DOE), the Environmental Protection Agency (EPA), and the Colorado Department of Health (CDH). EG&G's contractor will provide day-to-day management of the RI in accordance with this work plan. The decision makers have been and are involved in the OU5 DQO process through the Interagency Agreement (IAG), which specifies the minimum level of effort for the Phase I RI. The decision makers remain involved through the review and approval process specified in the IAG.

Primary data users are those individuals involved in ongoing RI activities. These are EG&G and EG&G's contractor technical staff. They will be involved in the collection and analysis of the data and in the preparation of the RI Report, including the Baseline Risk Assessment and the Environmental Assessment.

Secondary data users are those users who rely on RI outputs to support their activities. Secondary data users may include EG&G personnel working on other operable units or sitewide projects, EPA and CDH.

4.1.2 Evaluate Available Data

The historical and current conditions of each site are described in Section 2.0 of this work plan.

The following is a summary of the existing information based on the data presented in Section 2.0.

- Contamination by radioactive materials is known or suspected to exist at the Original Landfill (IHSS 115), Ash Pits (IHSS 13), C-Series Ponds (IHSS 142), in Woman Creek and in the South Interceptor Ditch.

- Metals contamination may also exist in these IHSSs, as well as in Woman Creek and the South Interceptor Ditch.

- Contamination at the IHSSs, if any, due to other substances is unknown at this time.

- The extent of contamination, if any, at the IHSSs in OU5 is unknown at this time.

- The presence of contamination is uncertain in the Surface Disturbance areas. Investigations should focus on confirmation of the presence or absence of contamination.

- There appears to be a potential for contamination from topographically or hydraulically upgradient sources (i.e., other operable units) to be present at the IHSSs.

4.1.3 Develop Conceptual Models

A generic conceptual model has been developed for the IHSSs in Subsection 2.7. This model includes description of potential sources, pathways and receptors. Since very few previous studies have been conducted, the model is basic. It is not known if the sources or pathways actually exist at the IHSSs.

4.1.4 Specify Phase I RFI/RI Objectives and Data Needs

Based on existing data and the IHSS conceptual models, site-specific Phase I RFI/RI objectives/data needs associated with identifying contaminant sources and the nature and extent of contamination are shown in Table 4-1. Identification of contaminant plumes will be used at several sites to assist in identification and characterization of contaminant sources.

The objectives of the Phase I RFI/RI are:

- To characterize the physical and hydrogeologic setting of the IHSSs
- To assess the presence or absence of contamination at each site
- To characterize the nature and extent of contamination at the sites, if present
- To support the Phase I Baseline Risk Assessment and Environmental Evaluation

That additional phases of investigation and risk assessment may be required at some IHSSs, particularly IHSS 115 (see Section 7.0).

4.2 STAGE 2 - IDENTIFY DATA USES/NEEDS

Stage 2 of the DQO process defines data uses and specifies the types of data needed to meet the project objectives. The summary of Stage 2 of the DQO process is presented as Table 4-1.

4.2.1 Identify Data Uses

RI/FS data uses can be described in general purpose categories:

- Site characterization
- Health and safety
- Risk assessment

- Evaluation of alternatives
- Engineering design of alternatives
- Monitoring during remedial action
- PRP determination

Since this work plan describes a Phase I RI, data uses such as engineering design and monitoring during remediation (both remedial action activities) will not be considered. The data use for PRP determination is also not appropriate to this work plan. The remaining four data uses will be important in meeting the objectives identified in Subsection 4.1.4.

4.2.2 Identify Data Types

Data types can be specified in broad groups initially and then divided into more specific components. For the Phase I investigation, soil, sediment, groundwater and surface water samples will be collected. In addition, radiation surveys will be conducted over most of the units. These data types will provide broad Phase I information regarding the presence or absence of contamination at the units. Selection of chemical analyses and physical testing will be based on the objectives of the Phase I program and on the past activities at the units. Data types are listed in Table 4-1 as sample/analysis methods.

4.2.3 Identify Data Quality Needs

EPA defines five levels of analytical data as follows (U.S. EPA 1987a):

- Level I - field screening or analysis using portable instruments. Results are often not compound-specific and not quantitative but results are available in real-time. It is the least costly of the analytical options.

- Level II - field analyses using more sophisticated portable analytical instruments: in some cases, the instruments may be set up in a mobile laboratory on site. There is a wide range in the quality of data that can be generated. The quality depends on the use of suitable calibration standards, reference materials, and sample preparation equipment; and the training of the operator. Results are available in real-time or several hours.

- Level III - all analyses performed in an off-site analytical laboratory. Level III analyses may or may not use Contract Laboratory Program (CLP) procedures, but do not usually utilize the validation or documentation procedures required of CLP Level IV analysis. The laboratory may or may not be a CLP laboratory.

- Level IV - CLP routine analytical services (RAS). All analyses are performed in an off-site CLP analytical laboratory following CLP protocols. Level IV is characterized by rigorous QA/QC protocols and documentation.

- Level V - analysis by non-standard methods. All analyses are performed in an off-site analytical laboratory which may or may not be a CLP laboratory. Method development or method modification may be required for specific constituents or detection limits. CLP special analytical services (SAS) are Level V.

The levels appropriate to the data need and data use have been specified in Table 4-1 for each data need. The levels as they apply to this work plan and specific analyses are presented in Table 4-2.

4.2.4 Identify Data Quantity Needs

Data quantity needs are based primarily on the quantities specified in the IAG. Additional data points have been added, where appropriate, to fill a data need. The Phase I data will be evaluated to determine the appropriate number of samples to be obtained in subsequent phases of the RI, as appropriate.

4.2.5 Evaluate Sampling/Analysis Options

The sampling/analysis approach for this Phase I work plan is based on a staged approach. Screening level sampling and analysis is followed by sampling of areas of anomalous radiation readings or other areas identified during screening. Where no data are available, a grid system will be used.

4.2.6 Review PARCC Parameter Information

PARCC (precision, accuracy representativeness, completeness and comparability) parameters are indicators of data quality. Precision, accuracy and completeness goals are established for this work plan based on the analyses being performed and the analytical levels. PARCC goals are specified in the Quality Assurance Addendum (QAA) in Section 10.0 of this work plan.

4.3 STAGE 3 - DESIGN DATA COLLECTION PROGRAM

The purpose of Stage 3 of the DQO process is to design the specific data program for the Phase I Woman Creek drainage RI. To accomplish this, the elements identified in Stages 1 and 2 and the IAG are assembled, and the Sampling and Analysis Plan (SAP) is prepared. The SAP consists of a Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPjP). These two components are addressed in Sections 7.0 and 10.0 of this work plan.

CONTROLLED DOCUMENT
ROCKY FLATS PLANT

5.0 PHASE I RCRA FACILITY INVESTIGATION/ REMEDIAL INVESTIGATION TASKS

5.1 TASK 1 - PROJECT PLANNING

Project planning will consist of the activities necessary to initiate the Phase I RCRA Facility Investigation (RFI)/Remedial Investigation (RI) of the Individual Hazardous Substance Sites (IHSSs) in the Woman Creek drainage. Activities undertaken for this project have included a review of previous investigations, historical aerial photographs, and other historical information. Results of this review are presented in Section 2.0 of this work plan. Prior to field investigations, it is necessary to complete the review of the existing data, including plant records and plans, available aerial photographs, and new data which become available after preparation of this work plan. The Interagency Agreement (IAG) also requires the submittal of several existing reports to the regulatory agencies. These reports will be assembled and reviewed during the project planning task.

Available aerial photographs will be reviewed again to assess the types and extent of activities at several of the IHSSs. A discussion of the aerial photograph review for each unit is included as the Step 1 work for each unit in Section 7.0 of this document. Available reports and plant plans will also be reviewed again. The findings of the aerial photo review and the records review will be used to finalize the field investigation program.

There are ongoing site studies at Rocky Flats of surface water and sediments, groundwater, geology (EG&G 1990b), background geochemistry (EG&G 1990c), and ambient air that may provide data that have bearing on the investigations in Woman Creek. These data will be compiled and evaluated during Task 1. Data from investigations at overlapping OUs will also be reviewed. For example, the need for additional surface water and sediment sampling locations will be dependent on the locations of ongoing sampling and the scope of analyses. If available data from ongoing investigations meet the requirements of the Phase I sampling and analysis plan, the samples proposed in Section 7.0 need not be collected again.

Other project-related documents are currently being prepared. The Sampling and Analysis Plan (SAP), which includes the site-wide Quality Assurance Project Plan (QAPjP) and Standard Operating Procedures (SOP) for field activities, is currently being completed by EG&G. The Health and Safety Plan (HSP) is also being completed by EG&G. The Field Sampling Plan (FSP) is included as Section 7.0 of this document. The Phase I FSP will be revised as necessary based on the findings of the photo and records review.

5.2 TASK 2 - COMMUNITY RELATIONS

The information contained in this section is summarized from DOE (1990b). In accordance with the IAG, dated January 22, 1991, the Communications Department at Rocky Flats is developing a plant-wide Community Relations Plan (CRP) to develop an interactive relationship with the public relating to environmental restoration activities. A Draft Community Relations Survey Plan has been completed and forwarded to the Environmental Protection Agency (EPA), the Colorado Department of Health (CDH), and the public for review. This plan specifies activities planned to complete the Environmental Restoration (ER) Program CRP, including plans for community interviews. The draft CRP was completed in September and the final CRP in November 1990, in accordance with the IAG schedules. Accordingly, a site-specific CRP is not required for Operable Unit Number 5 (OU5). The ER program community relations activities include participation by plant representatives in informational workshops, meetings of the Rocky Flats Environmental Monitoring Council, briefings of the public on proposed remedial action plans, and meetings to solicit public comment on various ER program plans and actions.

The Communications Department is continuing other public information efforts to keep the public informed on ER activities and other issues related to plant operations. A Speakers Bureau program sends speakers to civic groups and educational organizations, while a public tour program allows the public to visit Rocky Flats. An Outreach Program is also in place in which plant officials visit elected officials, the news media, and business and civic organizations to further discuss issues related to Rocky Flats and ER activities. The Communications Department receives numerous public inquiries which are answered through telephone conversations or by sending written informational materials to the requestor.

5.3 TASK 3 - FIELD INVESTIGATION

Phase I field investigations will be conducted at the IHSSs in Woman Creek to collect samples and data concerning the nature and extent of contamination, if any, at each unit. The data and sample results will be used to support the Phase I Environmental Evaluation and Phase I Baseline Risk Assessment, as well as meet the objectives and data needs described in Section 4.0 of this work plan. Additional phase(s) of investigation and risk assessment will be required for IHSS 115, and may be required at other IHSSs prior to Feasibility Studies.

Three types of activities will be performed during the Phase I field investigation: screening activities, sampling activities, and monitoring well installation. Screening activities include visual inspections, radiological surveys, magnetometer surveys and soil gas surveys. Sampling activities include surface soil sampling, subsurface sampling using test borings, surface water sampling, and sediment sampling. Monitoring wells will be installed and sampled at specified locations and in some test borings.

TITLE: Schedule

This is a CONTROLLED DOCUMENT
ENVIRONMENTAL MANAGEMENT
This is a RED Stamp

Approved By:
John L. Ottemann 2/24/92
Name (Date)

6.0 SCHEDULE

The schedule for conducting the Phase I Remedial Investigation is summarized in Figure 6-1. Dates shown are from the Interagency Agreement (IAG), dated January 22, 1991. According to the schedule, approximately 3 years will elapse from the time this work plan is finalized until the Phase I Remedial Investigation Report is issued.

TITLE: Phase I Field Sampling Plan (FSP)

Approved By: [signature] 2/29/92
Name (Date)

7.0 PHASE I FIELD SAMPLING PLAN (FSP)

7.1 BACKGROUND AND SAMPLING RATIONALE

7.1.1 Background

The objectives of the Phase I RCRA Facility Investigation (RFI)/Remedial Investigation (RI) are:

- To characterize the physical and hydrogeologic setting of the Individual Hazardous Substance Sites (IHSSs).
- To assess the presence or absence of contamination at each site.
- To characterize the nature and extent of contamination at the sites, if present.
- To support the Phase I Baseline Risk Assessment (BRA) and Environmental Evaluation.

Within these broad objectives, site-specific data needs have been identified in Section 4.0. The purpose of this section of the work plan is to provide a Field Sampling Plan (FSP) that will address data needs and data quality objectives. The FSP developed in this section is based on the requirements of the Interagency Agreement (IAG) Statement of Work for OU5, and the data needs developed in Section 4.0.

In the Phase I investigation for the Original Landfill (IHSS 115), data will be collected to define contamination boundaries and investigate the potential for contaminant migration. Based on the Phase I investigation results, a Phase II source characterization investigation will be performed. If warranted, an Interim Measures/Interim Remedial Action may also be performed at IHSS 115 once Phase I results are evaluated. Additional phases of investigation and risk assessment may be required at other IHSSs pending the Phase I results, although they are not anticipated at this time.

Generally, only limited information is available concerning the IHSSs in OU5 since there have been no previous field investigations of these sites. Available information includes aerial photographs, site histories, and some analytical data for samples collected near the IHSSs. Little information exists specific to the physical characteristics of the sites or to the nature and extent of the contamination, if present.

One of the objectives of the RFI/RI is to assess the presence or absence of contamination in the groundwater, surface water, sediments, and soils at the sites. A multi-staged approach is outlined in the IAG and will be used in Phase I to achieve this objective. This technique uses an "Observational Approach" involving continuing reassessment of the site conditions as data are obtained. As data is collected and interpreted, specific sampling plans will be formulated to build on existing information. These sampling plans for subsequent stages of investigation will be submitted as Technical Memoranda (TMs) to the EPA and CDH for review prior to implementation. TMs will be used specifically for the investigation of IHSSs 115 and 133 (Original Landfill and Ash Pits) because of their complexity. They are more thoroughly discussed in the applicable sections of this FSP.

7.1.2 Sampling Rationale

As discussed above, a staged approach will be used for the sampling program. There are four stages that may be completed at any site.

- **Stage 1** consists of a review of existing data, including aerial photographs and site records. Data from ongoing or other OU investigations that have become available since preparation of this Phase I work plan will be compiled and evaluated. These data will be validated as appropriate for incorporation into the OU5 site characterization. This review of existing information has already been partially performed during preparation of this Phase I work plan.

- **Stage 2** involves screening activities, including radiation, magnetometer, electromagnetic (EM), and soil gas surveys. These activities are designed to provide Phase I screening-level data concerning the presence or absence of contaminants at some of the sites. These surveys will be conduced in the order listed. Each screening activity will be preformed after review of the previous screening method.

- **Stage 3** consists of Phase I sampling activities for soil, sediment, and surface water. Soil borings will be completed at some IHSSs to collect samples at depth and to characterize the IHSS. Some of the sampling locations may be selected to investigate anomalies identified in the Stage 2 screening surveys. This stage will provide confirmation of the Phase I screening data as well as aid in Phase I geologic and hydrogeologic characterization of the sites.

- **Stage 4** involves cone penetrometer surveys, monitoring well installation, and groundwater sampling. Cone penetrometers will be used to characterize subsurface lithology, to help locate vadose zone water or groundwater, and to help guide installation of monitoring wells. If pore pressure in the vadose zone indicates the presence of water, a BAT sampler (or equivalent) will be inserted to take a sample. Groundwater monitoring wells will be installed to characterize the hydrogeologic setting of each site and to monitor alluvial groundwater conditions within or downgradient of several sites. These wells will be sampled after completion and development, and the results will be included in the Phase I RFI/RI Report.

- **Stage 5** consists of additional sampling or surveying activities unique to each IHSS.

7.1.3 Modifications to the IAG Plan

Several sampling and analytical activities described in the IAG have been modified in this FSP. These modifications, listed below, have been made so that each IHSS can be better evaluated during the Phase I investigation. Modifications to the Phase I sampling program are presented first followed by modifications to the Phase I analytical program.

Phase I Sampling Program Modifications

1) Radiation surveys and limited soil sampling, including surface soil samples and soil borings, will be conducted at the three Surface Disturbance areas: the IHSS 209, the Surface Disturbance south of Ash Pits and the Surface Disturbance west of IHSS 209. The purpose of these activities is to assess the presence or absence of contaminants at these sites. The rationale for this sampling is that if contamination is not found, the surface disturbances can be removed from further phases of the RFI/RI process.

2) An investigation of a second surface disturbance (south of the Ash Pits) has been added to the Phase I investigation. This is an area where unknown activities have taken place at excavation and fill areas. The investigation of this area will include a review of the aerial photos, a radiation survey, surface soil sampling, and 11 soil borings. Details of this program are contained in Subsection 7.2.4.

3) An investigation of a third surface disturbance west of IHSS 209 has been added to the Phase I investigation. The investigation of this area, which appears to have been a radio tower installation, will include a review of the aerial photos, a radiation survey, and surface soil sampling and soil borings. Details of this program are contained in Subsection 7.2.4.

4) No FIDLER radiation survey will be conducted at the Original Landfill (IHSS 115). This survey has been deleted from the Phase I investigation because a more comprehensive gamma radiation survey using a germanium detector was completed in the fall of 1990. Known radiation anomalies are discussed in Subsection 7.2.1. In addition, a gamma radiation survey using a germanium detector will be used at the Ash Pits (IHSS 133) instead of the radiation surveys specified in the IAG.

5) Two-foot composite samples will not be used for volatile organics analysis at the Original Landfill (IHSS 115). Instead, discrete samples will be collected at 2-foot increments for analysis. Composite samples are not appropriate for analysis of volatile organic compounds, since a significant portion of the volatiles present in a sample can be volatilized during compositing of a sample.

6) Five sediment samples are to be collected from both Ponds C-1 and C-2 (IHSSs 142.10 and 142.11), as proposed in the IAG. However, three of the five locations have been changed so that more representative samples of the pond sediment can be obtained. The five locations proposed in this Phase I FSP are:

- In the deepest portion of the pond.
- In the pond, 5 feet from the inlet.
- At three randomly selected locations within the pond.

The samples to be collected at the three random locations are the locations which have been changed from those specified in the IAG. These random samples will provide pond sediment data that can be statistically averaged, while the samples collected from the deepest part of the ponds are likely to provide worst case concentrations. These average and worst case concentrations can then be used to better characterize the extent and nature of any contamination in the ponds and provide more useful data for the Phase I BRA. The three original sampling locations specified in the IAG would provide non-random data that cannot be used in statistical analyses.

7) Sediment samples from Woman Creek and the South Interceptor Ditch (SID) will be collected to characterize the drainage where existing data is currently lacking. These samples will be placed just downstream of the impact area (area where surface runoff from an IHSS reaches Woman Creek) for each IHSS along Woman Creek and along stream segments that need further characterization. Based on a review of the data collected at the existing 18 sediment sample locations, there exists a significant amount of information about the sediment in many parts of the OU5 drainages (see Section 2.0). Based on this approach, two additional sampling locations have been placed downstream of the Ash Pits, four downstream of the Old Landfill, one between the Old Landfill and Pond C-1, one between Ponds C-1 and C-2, and four downgradient of Pond C-2. These 12 proposed sampling locations in combination with the existing 18 sampling locations should be sufficient to characterize the Woman Creek and SID sediment.

The IAG states that all sediment samples will represent the entire vertical column of sediment present at each location, and if the sediment depth is greater than 2 feet, individual 2-foot composites will be collected. This technique could potentially dilute any surficial contamination. Instead, the top 2 inches of bed material will be collected for VOC analysis and 6-inch core will be collected for analysis of all other parameters. Standard Operating Procedure (SOP) SW.6 will be followed for sediment sampling. This SOP is presented in Section 11.0.

8) Eight borings will be drilled and sampled in the Original Landfill (IHSS 115) area. One boring will be drilled at the location of each of the two former ponds and six borings will be drilled in the disturbed area east of the landfill. The borings will be drilled 6 feet into weathered bedrock.

Samples will be analyzed for the same constituents as other soil samples from the landfill (as presented in Table 7-1). There have been no previous investigations in either the areas of the former ponds or the disturbance east of the landfill. These borings will provide Phase I data concerning the presence or absence of contamination at these locations.

9) One additional well will be installed downgradient of the Old Landfill (IHSS 115). The well will be located between existing wells 5786 and 7086 south of the SID. The well will be completed in the alluvial materials.

10) A magnetometer survey and an EM geophysical survey will be conducted at the Old Landfill (IHSS 115) and Ash Pits (IHSS 133). In addition, two cone penetrometer surveys will be performed downgradient of the Original Landfill. The magnetometer surveys will be used to evaluate the presence of ferrous materials in the units. The EM survey will determine differences in the conductivity of subsurface materials, which may allow evaluation of the IHSS boundaries, presence of contamination, and/or the presence of saturated material. The cone penetrometer will be used to identify saturated subsurface material for subsequent soil water sampling between the landfill and the SID, and between the SID and Woman Creek. The information gathered from the cone penetrometer will be used to define the best locations and depths for groundwater monitoring wells or if appropriate, vadose zone sampling using the BAT sampler.

11) Soil borings were initially proposed in the IAG to delineate the boundaries of the Ash Pits, Incinerator and Wash Pad (IHSS 133). Borings were proposed to be placed on 25-foot centers that transect each site. If the boundaries of IHSS 133 can be determined by aerial photography review, radiation survey and/or the proposed geophysical surveys, fewer soil borings will be necessary. The purpose of these borings would be to characterize the contamination sources at IHSS 133. The number of location of borings will be addressed in a TM.

12) Surface soil sampling for plutonium and other radionuclides may be preformed at the Rocky Flats Plant site between Woman Creek and the southern boundary pending further data evaluation. This is discussed in Subsection 7.2.4.1. Sediment and surface water sampling in this area is also discussed in this section.

Phase I Analytical Program Modifications

1) All the Phase I soil samples collected from the Ash Pits area (IHSSs 133.1-133.6) will be analyzed for target analyte list (TAL) metals as well as for uranium, plutonium, americium, gross alpha, and gross beta. This should provide a more representative analysis of the wastes thought to be present in these pits. This is also appropriate, since the groundwater monitoring program calls for analysis of metals in wells downgradient of this IHSS. Details of this analytical program are summarized in Subsection 7.3.2.

TABLE 7-1

PHASE I INVESTIGATION
IHSS 115 - ORIGINAL LANDFILL

Activity	Purpose	Location	Sample Number
Stage 1			
1. Review Aerial Photographs	Identify extent of the Original Landfill and disturbed area east of Landfill	Landfill area and eastward	NA
2. Review Gamma Radiation (RAD) Survey	Identify areas of anomalous radiation readings	Landfill area	NA
Stage 2			
3. Magnetometer Survey	Locate ferrous objects	Entire landfill area - 25-ft. grid	2,490
4. EM Survey	Locate ferrous objects, and help locate IHSS boundaries	Entire landfill area - 25-ft. grid	2,490
5. Soil Gas Survey	Locate plumes of volatile organics	Entire landfill area - 100-ft. grid Modified at perimeter to 25-ft. grid	To be determined
Stage 3			
6. Surficial Soil Samples	Characterize surface contamination; characterize RAD survey anomalies	Random basis throughout landfill and within RAD survey anomalies	To be determined statistically; 2 samples per RAD survey anomaly
7. Soil Cores	Verify soil gas survey readings (false negatives)	One random sample every 15 soil gas samples taken at the depth of the soil gas probe	To be determined
8. Soil Borings	Characterize subsurface conditions and contamination	One boring in each area of the two former ponds, six in the disturbed area east of the landfill	8
9. Soil Borings, if plumes identified	Transect and sample plumes, if identified by soil gas survey	Three borings transecting each plume, one boring at highest soil gas reading and two additional borings downgradient of the first.	To be determined
10. Sample sediment and surface water	Characterize sediment and surface water downgradient of landfill	Two locations along SID and three locations on Woman Creek	4 sediment and 6 surface water
Stage 4			
11. Cone Penetrometer/Sampler	Characterize subsurface conditions and lithologies; characterize subsurface fluids and/or gases	Two lines on 100 ft. spacing downgradient of landfill	To be determined

TABLE 7-1

PHASE I INVESTIGATION
IHSS 115 - ORIGINAL LANDFILL
(Continued)

	Activity	Purpose	Location	Sample Number
12.	Install wells in borings, if plumes identified	Monitor subsurface plumes, if identified	In borings at the points of highest readings	Maximum of 3
13.	Install wells and/or vadose zone sampling devices	Monitor subsurface conditions	To be determined based on data collected	To be determined
Stage 5				
14.	Review plant plans, conduct sewer snake survey	Confirm connections of two pipes daylighting in the landfill	Two pipes in landfill	NA
15.	Sample pipe effluent if following	Characterize effluent	Pipe outfalls	2

NA - Not Applicable

2) A gamma radiation scan will be conducted by EG&G or its contractor on each of the sediment samples collected from the location at the deepest portion of Ponds C-1 and C-2 (IHSSs 142.10 and 142.11). Sediment samples at these locations will be collected from the sediment core at 5-centimeter intervals. The rationale behind including this analysis is to evaluate whether contamination may exist in thinly stratified layers and to provide additional data to characterize pond sediment.

3) The IAG specifies that water and sediment samples be analyzed for soluble and insoluble radionuclides and metals. For the purposes of this Phase I investigation, each of the water samples will be filtered, and both the filtered and an unfiltered aliquot will be analyzed for the specified metals and radionuclides. The filtered sample will provide data on the dissolved constituents and the unfiltered sample will provide data on the total constituent concentrations. Also, water (both filtered and unfiltered) and sediments will be analyzed for both plutonium isotopes (Pu-239 and Pu-240). This is consistent with the existing Rocky Flats analytical methods.

4) Several analyses have been added to the Phase I analytical program to address chemicals of interest in the Environmental Evaluation. Borehole samples at the Original Landfill (IHSS 115) and some of the surface water and sediment samples collected in Woman Creek will be analyzed for target compound list (TCL) pesticides/polychlorinated biphenyls (PCBs). All surface (0-2 inches) soil samples taken in OU5, and sediment samples collected in Woman Creek will be analyzed for total organic carbon (TOC).

5) The two sediment samples downgradient of the Ash Pits will not be analyzed for TCL volatiles and semi-volatiles. These organic compounds are unlikely to be present in the ash disposed of in these IHSSs and organics have not been detected in the data collected from existing sediment locations in and adjacent to Woman Creek near the Ash Pits. Radionuclides and TAL metals are the suspected contaminants at the Ash Pits and the sediment analytical program downgradient of these areas will focus on these analytes.

7.2 PHASE I INVESTIGATION PROGRAM

This section describes the Phase I investigation program for the IHSSs within OU5. For each IHSS, the tasks listed are generally divided into office activities prior to field sampling (Stage 1), field screening activities prior to sampling (Stage 2), field sampling activities (Stage 3), and groundwater monitoring well installation and sampling (Stage 4). As part of the field sampling program, data from site-wide monitoring programs and investigations at other OUs will be used as appropriate to add to, or substitute for, the data collected during the Phase I investigation. The sites included within OU5 are IHSS 115 - Original Landfill; IHSS 133 - Ash Pits 1-4, the Incinerator, and the Concrete Wash Pad; IHSS 142.10 and 142.11 - C-Series Detention Ponds, and IHSS 209 - Surface Disturbance southeast of Building 881 and

two additional surface disturbances; these are the surface disturbance west of IHSS 209 and the surface disturbances south of the Ash Pits. The area south of OU5 to the property boundary will be investigated, if warranted. For reference, the Phase I investigation programs for each IHSS are summarized below. A number of SOPs will be used during the investigation. The SOPs are cited in this section and discussed further in Section 11.0 of this Phase I work plan.

7.2.1 IHSS 115 - Original Landfill

Stage 1 - Review Aerial Photographs and Gamma Radiation Survey Results

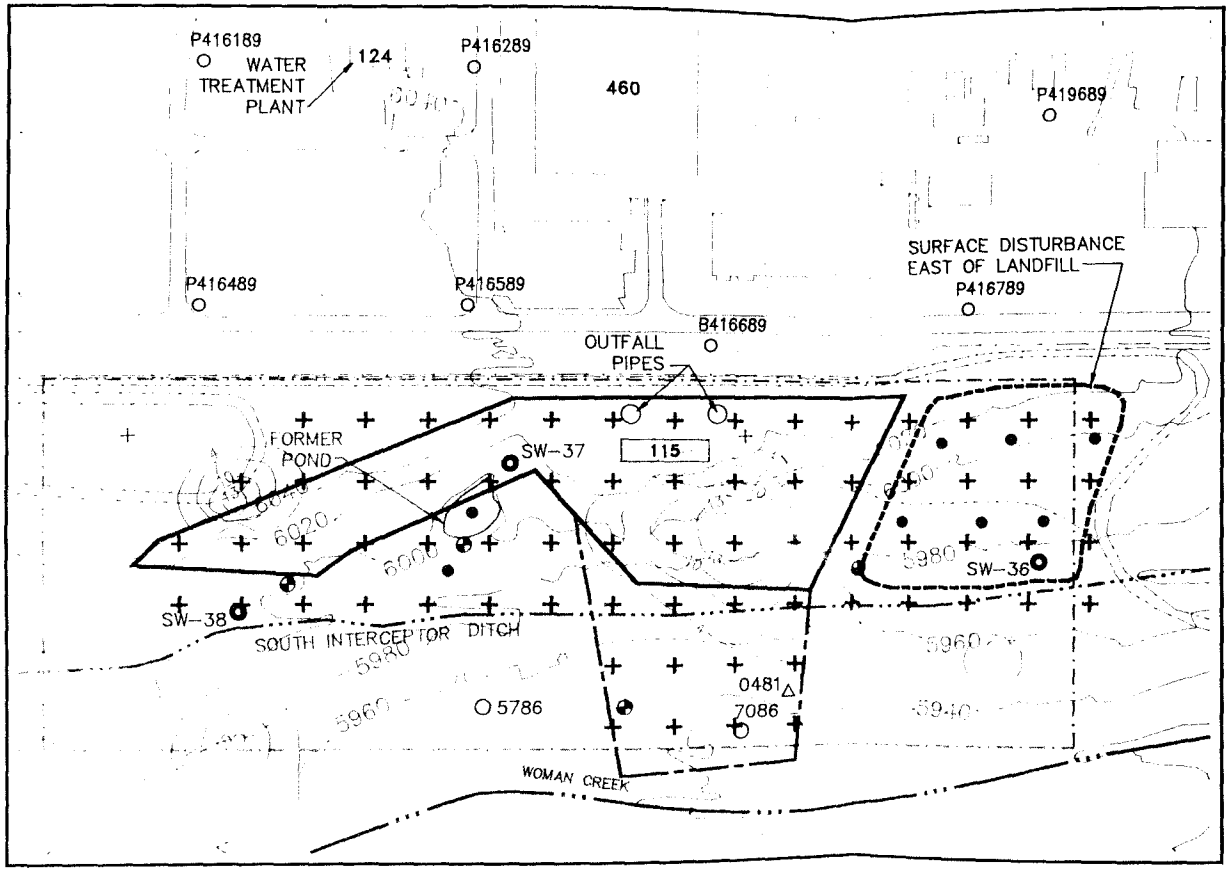
Aerial photographs taken during operation of the Original Landfill will be reviewed to identify the extent of the Original Landfill and the disturbed area located to the east of the Original Landfill. The areas to be studied during later steps of this investigation, including the location of former ponds, will be delineated from the aerial photographs and surveyed in on the ground as needed to define their locations for the Phase I field work. Additional studies conducted at the Landfill after preparation of this Phase I work plan will be evaluated during Stage 1 (see Table 7-1). Also as part of this stage, the gamma radiation survey conducted at the Original Landfill in Fall 1990, using a germanium detector (Appendix B) will be further reviewed, and the elevated radiation readings shown on Figure 7-1 will be surveyed on the ground to define their locations.

Stage 2 - Magnetometer, EM, and Soil Gas Surveys

A magnetometer survey will be performed over and downgradient of the Old Landfill and the disturbed area to the east (Figure 7-1). This survey will be conducted on a 25-foot grid in the area outlined for the radiation survey in Figure 7-1. The survey will be completed according to the magnetic locator procedure in SOP GT.10. Resulting anomalies will be mapped and contoured.

An EM geophysical survey will be performed over the Old Landfill on the same 25-foot grid established for the magnetometer survey and will cover the same area. The survey will be completed according to the EM geophysical procedures in SOP GT.18. Details of both the magnetometer and EM geophysical survey will be supplied to the Agencies for review in a TM. The TM will include the type of geophysical surveys to be performed, procedures, and grid spacing.

A real-time soil gas survey will be conducted over the Original Landfill and the disturbed area located to the east of the Landfill (Figure 7-1) to identify areas of volatile organic contamination. As specified in the IAG, the soil gas samples will be taken on a 100-foot grid according to the procedures described in SOP GT.9. To further improve the sampling coverage, the grid will be reduced to 25-foot spacing at the downgradient perimeter of the landfill, over areas of suspected buried metallic materials based on the magnetometer and EM survey, and over areas where volatiles are found during the 100-foot grid soil gas survey. The perimeter of the landfill will be defined by the aerial photograph interpretation, radiation,



N

0 100 200

SCALE: 1" = 200'

EXPLANATION

- 115 — INDIVIDUAL HAZARDOUS SUBSTANCE SITE
- SW-1 — EXISTING SURFACE WATER SAMPLING LOCATION
- 5786 — EXISTING ALLUVIAL GROUNDWATER MONITORING WELL
- 0481 — PRE-1988 MONITORING WELL
- INTERMITTENT STREAM
- DIRT ROAD
- 124 — ROCKY FLATS BLDG. NO.
- PRELIMINARY EXTENSION OF THE LANDFILL BASED ON A 1974 RECONNAISSANCE
- PROPOSED WELL LOCATION*
- PROPOSED SOIL BORING LOCATION*
- PROPOSED SOIL GAS SAMPLES*
- 238U (pCi/G) ISOCONCENTRATION CONTOURS
- 1990 GERMANIUM SURVEY BOUNDARY AROUND OLD LANDFILL

*ALL PROPOSED LOCATIONS ARE APPROXIMATE

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OPERABLE UNIT 5
PHASE I RFI/RI WORK PLAN

PROPOSED SAMPLING AND WELL LOCATIONS
IHSS 115
ORIGINAL LANDFILL

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FIGURE 7-1

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magnetometer, and EM survey review, and by field reconnaissance. The 25-foot soil gas grid spacing around the downgradient perimeter will cover at least the area between the last 100-foot grid location within the landfill area and the first 100-foot grid location outside the landfill area (see Figure 7-1). The 25-foot soil gas grid located over metallic materials or volatile plumes will continue for at least 50 feet beyond the edge of the anomaly. This approach should better characterize the area of likely contamination. A probe will be driven approximately 5 feet into the soil to collect the soil gas. The soil gas samples will be analyzed for 1,1,1-trichloroethane (TCA), dichloromethane, benzene, carbon tetrachloride, tetrachloroethene (PCE), and trichloroethene (TCE) using a portable gas chromatograph (GC). Analytical peaks of compounds for which the GC is not calibrated will be noted. It will not be possible to analyze for solvent breakdown products like 1,2-dichloroethane and vinyl chloride with a GC because they co-elute with other compounds. Vinyl chloride co-elutes with freon compounds, and 1,2-dichloroethane co-elutes with methyl ethyl ketone and dibromomethane. The analytical program for the soil gas survey is discussed in Subsection 7.3.2. Details of the proposed soil gas surveying grid will be presented to the Agencies for review in a TM.

Stage 3 – Surface Soil, Soil Core, Soil Boring, Sediment, and Surface Water Samples

Randomly located surficial soil samples will be collected to characterize the landfill cover material and exposed fill material using the Rocky Flats method. Depending upon the results of the radiation screening, additional surface soil samples may be required at identified areas with above background radiation. These samples will help establish whether the landfill is leaking via fugitive dust entrained in air for risk assessment purposes. In addition, based on the review of the gamma radiation survey, additional surficial soil samples will be collected within the areas that have above background radiation. At least two samples will be collected at small or point sources of radiation and at least three will be collected over disturbed areas. A TM will be submitted to the Agencies for review prior to implementation that will specify the exact number of samples necessary for the risk assessment, and identify the sampling locations and sampling method protocol.

Soil cores will be collected on a random basis to verify the soil gas survey and other screening methods (e.g., false negative). One soil core (grab sample) will be collected for every 15 to 20 soil gas samples at the same depth as the soil gas samples. Based on the number of original grid soil gas sampling locations, it is estimated that four soil cores will be collected.

Three soil borings will be placed at up to three areas where plumes have been identified by the soil gas survey. This will result in a maximum of nine soil borings being drilled at the three plume areas. At each plume area, one soil boring will be placed at the point of the highest soil gas reading, and two borings will be located downslope of that point within the plume identified by the soil gas survey.

Soil borings will also be drilled for subsurface characterization purposes. One soil boring will be drilled in the location of each of the two former ponds. Six soil borings will be drilled in the disturbed area east of the landfill. Each soil boring will be drilled at least 6 feet below the base of the alluvial material

according to the procedures described in SOP GT.2. Samples will be taken continuously in these borings. Discrete samples will be collected from every 2-foot increment and analyzed for the TCL volatile organic compounds (VOCs). Samples will be composited from every 6-foot interval and analyzed for the TCL semivolatile organic compounds, the TAL metals, and radionuclides. As specified in the SOP, samples will not be collected for chemical analysis from the saturated alluvium. The analytical program for those samples is presented in Subsection 7.3.

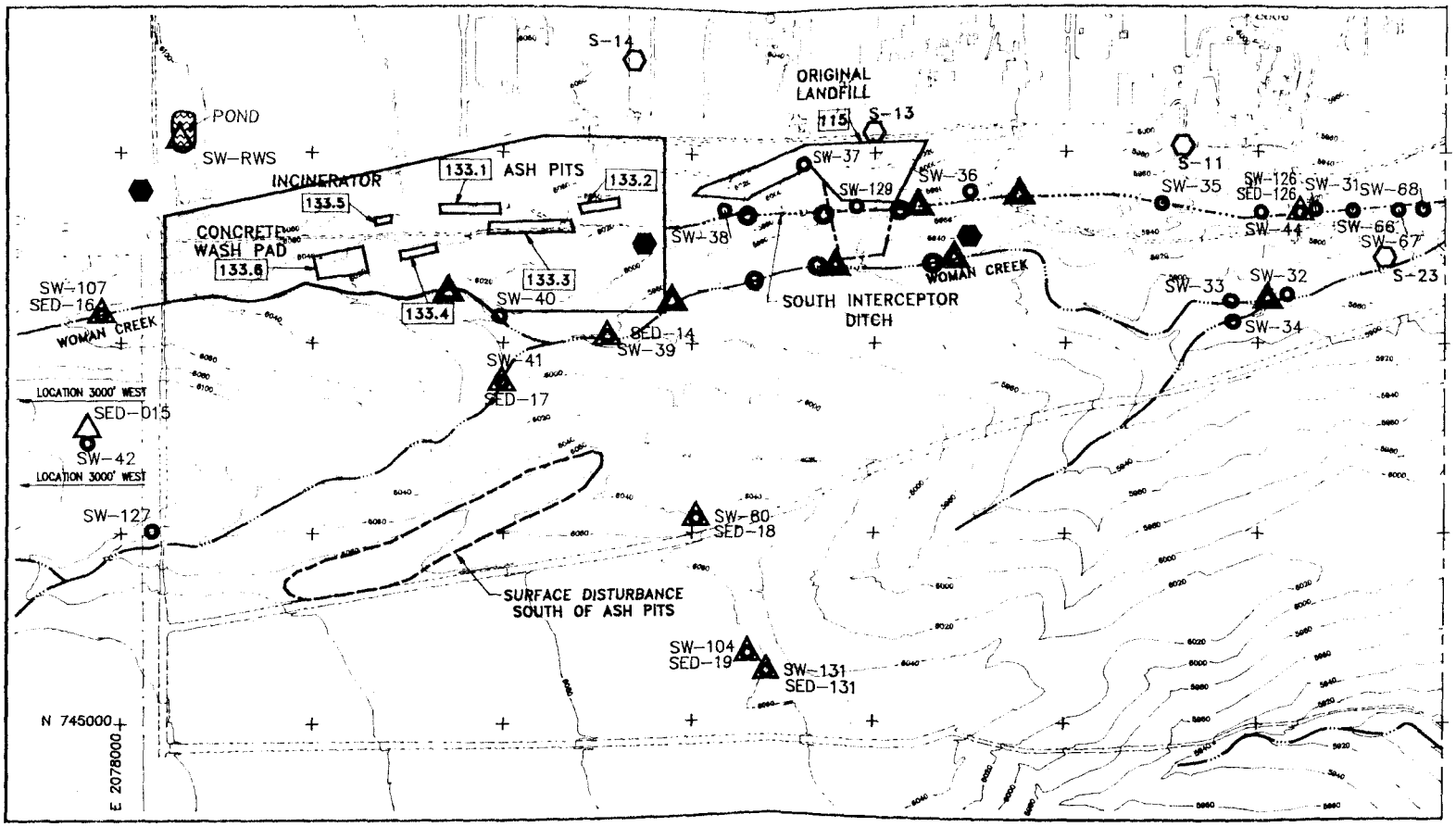
During sampling a soil classification survey will be completed at the Original Landfill for use in the Environmental Evaluation. Several samples may also be collected from 0 to 2 feet for grain size analysis.

The sediments and surface water of the SID and Woman Creek will be sampled immediately downgradient of the Original Landfill. These locations are shown in Figure 7-2, which is a map of all the proposed surface water and sediment sampling locations for OU5. Surface water samples will be collected at three locations along the SID and three locations on Woman Creek (total of six samples) according to the procedures specified in SOPs SW.2 and SW.3 for surface water. Sediment samples will be collected at two locations along the SID and two locations on Woman Creek (total of four samples) according to procedures specified in SOP SW.6 (see Subsection 7.2.3). The sediment samples will be collected in areas of the creek or ditch that are conducive to sediment accumulation. The analyses to be performed on these samples are listed in Subsection 7.3.

Stage 4 – Cone Penetrometer, BAT Sampler (or equivalent), Monitoring Well Installation and Groundwater Sampling

A cone penetrometer will be used to establish subsurface conditions and lithologies downgradient from the landfill. One subsurface condition that is essential to characterize is soil moisture and/or saturation. A cone penetrometer with this capability will be used. Two lines of cone penetrometer surveys will be taken with a maximum of 100-foot spacing between penetrometers; one line will be between the Landfill and the SID, and one line between the SID and Woman Creek (see Figure 7-1). In the appropriate cone penetrometer survey locations (locations where significant soil moisture is present), BAT sampling, or an equivalent, will be used to sample any encountered groundwater or interstitial fluid. These samples are necessary to help establish whether contaminated plumes are presently leaking from the landfill. To calibrate the cone penetrometer, one of the soil borings discussed above will be "twinned" so that the cone penetrometer will penetrate known lithologies and saturations. A TM will be submitted to the Agencies for review outlining the details of the cone penetrometer use, type of sampler, spacing and analyte list.

Based on information from the magnometer, EM, and soil gas surveys, and cone penetrometer data, the location for alluvial monitoring wells will be determined. Final locations for the monitor wells will be submitted to the Agencies for review in a TM. It is possible due to the limited saturated thickness of the alluvium, that there may be locations where there is no water or times of the year when the saturated



EXPLANATION

- 115 — INDIVIDUAL HAZARDOUS SUBSTANCE SITE
- SW-1 — EXISTING SURFACE WATER LOCATION
- SED-1 — EXISTING SEDIMENT SAMPLING LOCATION
- INTERMITTENT STREAM
- DIRT ROAD
- PRELIMINARY EXTENSION OF THE SURFACE DISTURBANCE BASED ON A RECONNAISSANCE
- S-23 — EXISTING RADIOACTIVE AMBIENT AIR MONITORING PROGRAM LOCATION
- PROPOSED SEDIMENT SAMPLE LOCATION
- PROPOSED RADIOACTIVE AMBIENT AIR MONITORING PROGRAM LOCATION
- PROPOSED SURFACE WATER LOCATION
- PROPOSED GERMANIUM SURVEY FOR ASH PIT AREA

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Rocky Flats Plant, Golden, Colorado

OPERABLE UNIT 5
PHASE I RFI/RI WORK PLAN

SEDIMENT & SURFACE WATER SAMPLING SITES & AIR MONITORING STATIONS ALONG WOMAN CREEK AND THE SOUTH INTERCEPTOR DITCH

FIGURE 7-2 (1 OF 2)

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Figure 7-2 (cont.)

thickness is zero. If this is the case, it may be necessary to relocate the wells or possibly install a vadose zone sampling device such as the BAT sampler (or an equivalent) capable of characterizing the contaminant plumes in zones of limited water. It may also be necessary to install bedrock wells beneath zones of contaminated alluvial groundwater or if a subcropping sandstone is encountered. The need for bedrock wells will be evaluated after lithologic and preliminary chemistry data has been gathered and interpreted. At this time it is proposed that a maximum of three monitoring wells will be installed in these borings. As specified in the IAG, all of these wells will be installed in the alluvium just above the bedrock according to SOP GT.6.

In addition to the above wells, four alluvial monitoring wells and/or vadose zone samplers will be installed in the alluvium downgradient of the Original Landfill. The location, type, and number of monitoring devices will be dependent upon the results of all other data gathered in this Phase I investigation. At this time, it appears at least three wells should be installed between the Landfill and the SID, and one well installed between the SID and Woman Creek: locations shown on Figure 7-1 are tentative. The first well will be placed approximately between the western leg of the Landfill and the SID. The second well will be placed in the alluvium in the surface drainage north of Well 5786 between the Landfill and the SID within the area of the old embankment. The third well will be placed in the alluvium between the southeastern corner of the boundary of IHSS 115 and the SID, downgradient of the outfall identified on the east side of the Landfill. The fourth well will be placed between existing wells 5786 and 7086. These locations may be modified slightly depending upon the results of the screening surveys. If a water-bearing sandstone unit is found to be the first bedrock unit underlying the alluvium in a boring, then an additional well will be completed in the sandstone at that location. The use and location of the proper type of monitoring device should be able to ascertain both present and future contaminant levels and help establish any future or present contaminant migration problems. The locations for the monitoring devices should allow for monitoring the principal groundwater and downgradient migration pathways of the Old Landfill.

All groundwater monitoring wells will be drilled according to SOP GT.2 and installed according to SOP GT.6. All wells will be developed according to SOP GW.2. Following development, wells will be sampled according to SOPs GW.5 and GW.6. The analyses to be performed on these samples are listed in Subsection 7.3. The results of the first round of sampling will be reported in the Phase I RI Report. The four monitoring wells downgradient of the Landfill will be sampled quarterly for a minimum 1 year.

Stage 5 – Outfall Pipe Location, Source, and Sampling

The two corrugated metal pipes protruding from the Landfill (Figure 7-1) will also be investigated in this FSP. Plant plans will be reviewed and a sewer snake survey will be conducted to attempt to identify the open length of the pipes and the sources of water. This survey may use a traceable electronic or magnetic source attached to the snake such that surface instruments can be used to follow the path of the pipe. Other methods for locating pipes may also be used if the sewer snake survey is

inconclusive. If water is found to be flowing through either of the corrugated pipes during this Phase I investigation, the effluent will be sampled according to SOP SW.3. Results of the sampling will be reported in the Phase I RI Report.

7.2.2 IHSS 133 - Ash Pits 1-4, Incinerator, and Concrete Wash Pad

Stage 1 – Review Aerial Photographs

Aerial photographs from 1953, 1955, 1964, 1969, and 1978 through 1988 will be reviewed to identify the extent of the disposal areas for these sites including an area north of the west access road and possible waste disposal areas beyond the boundaries of Ash Pit 1 and the Concrete Wash Pad (see Section 2.0). The dimensions of each pit, determined from the aerial photographs, will be land surveyed in and used to assist in planning the Phase I drilling program and for defining the area of the radiation survey (see Figure 7-2 and Table 7-2).

Stage 2 – Radiation, Magnetometer and EM Geophysical Surveys

A ground based radiation survey employing a high purity germanium gamma-ray sensor will be performed over the four Ash Pits, the Concrete Wash Pad, and the Incinerator. The area to be surveyed for IHSS 133 is shown on Figure 7-2 and extends from the western boundary of the previously surveyed area over the Original Landfill (Appendix B) to approximately 600 feet west of the Concrete Wash Pad. The sodium iodide sensors employed for this survey will be spaced such that there is overlapping coverage between stations to guarantee that there is 100% coverage. The gamma emitting radionuclides that are detected will be analyzed to identify the isotopes that may be present. An SOP is currently being developed for performing this survey. If areas of anomalous radiation readings are detected, they will be surveyed and staked sufficiently to define their lateral extent. The results will be plotted and contoured on a map and will also be presented in tabular form.

Using the Observational Approach, a magnetometer and an EM geophysical survey may be performed over the Ash Pits in the same area as outlined for the radiation survey on Figure 7-2 to help locate the boundaries of each IHSS. These surveys will be performed if the results of the previous activities fail to outline the locations of the Ash Pits 1-4, Incinerator, and Concrete Wash Pad. These surveys would be conducted on a 25-foot grid according to the magnetic locator procedure described in SOP GT.10 and according to the EM geophysical procedure described in SOP GT.18. Resulting anomalies would be mapped and contoured. Prior to implementation, the need for, and as appropriate, the details of the magnetometer and EM surveys will be presented to the Agencies for review in a TM. Type of instrumentation, grid spacing, operating procedures, and justification for use or non-use will be included.

TABLE 7-2

PHASE I INVESTIGATION
IHSS 133 - ASH PITS 1-4, INCINERATOR, AND CONCRETE WASH PAD

Activity	Purpose	Location	Sample Number
Stage 1			
1. Review Aerial Photographs	Identify extent of the areas, including areas beyond the boundaries of the units	Entire site and north of road	NA
Stage 2			
2. Radiation Survey	Locate areas of anomalous radiation readings	IHSS areas, areas between pits, and area between Ash Pits and Landfill	NA
3. Magnetometer Survey	Locate metallic objects	IHSS areas, areas between pits, and area between Ash Pits and Landfill	4,864
4. EM Survey	Locate metallic objects and contaminant plumes	IHSS areas, areas between pits, and area between Ash Pits and Landfill	4,864
Stage 3			
5. Surface Soil Sampling	Characterize radiation anomalies	Central location of areas of radiation above background	Unknown
6. Soil borings	Characterize subsurface conditions and contamination	Within pits and over hotspots. Borings will be drilled 5 ft. into weathered bedrock.	To be determined
Stage 4			
7. Install wells	Monitor alluvial groundwater downgradient of the unit	See Figure 7-3	3

NA - Not Applicable

Stage 3 – Surface Soil Sampling and Soil Borings

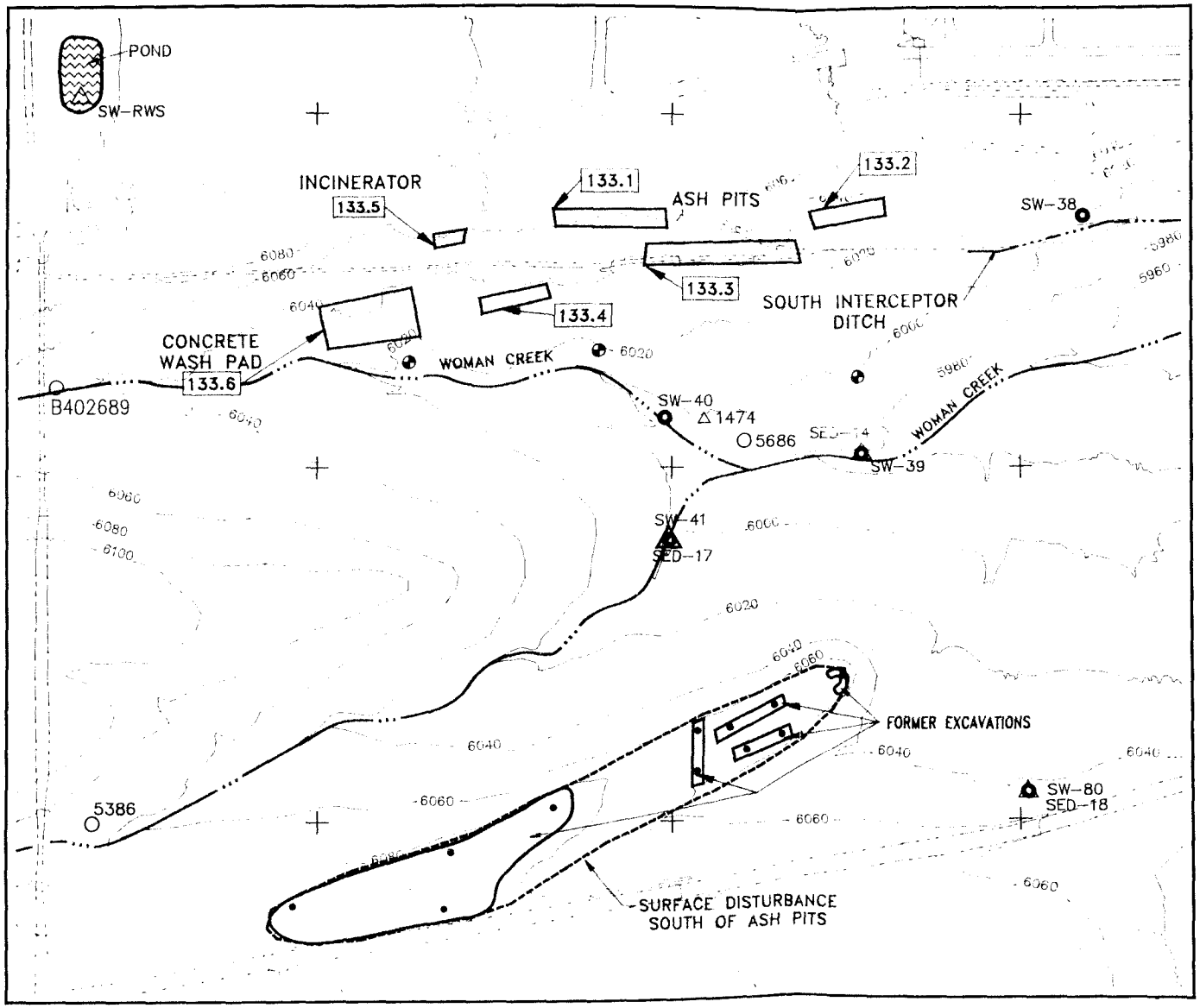
Surficial soil samples will be collected from random locations to characterize any contamination in surface soils that may have resulted from operation of the incinerator. In addition, surface soil samples will be collected for radiochemical analysis at the central location of all areas identified by the radiation survey as having above-background radiation levels. These soil samples will be used to characterize migration pathways for surface contaminants in the risk assessment. Samples will be collected according to the sampling procedures specified in SOP GT.8. A TM will be issued to the Agencies for review prior to implementation that specifies the number of samples, sampling locations and operating procedures that meet the objectives for the risk assessment.

Soil borings will be drilled during the Phase I investigation to characterize cover and subsurface materials. Soil borings are stipulated in the IAG to delineate the boundaries of the Ash Pits, Incinerator and Wash Pad. Borings were to be placed along the short axis of each pit. Based on the present size of the Ash Pits, Incinerator, and Wash Pad, it was estimated that approximately 85 borings on 25-foot centers would be drilled in the area. Using aerial photo interpretation and the results of the magnetometer and EM surveys, if necessary, the number of soil borings needed may be significantly reduced to characterize the subsurface material. The soil boring program will be presented to the Agencies for review in a TM prior to implementation. Soil borings will also transect each area of anomalous radiation readings detected during the radiation survey. At this time, it is proposed that each boring be drilled 5 feet into weathered bedrock and be drilled and sampled according to procedures contained in SOP GT.2. Samples would be taken continuously in these borings. Samples would be composited from every 2-foot interval and analyzed for metals, total uranium, plutonium, americium, chromium, gross alpha, and gross beta (see Subsection 7.3).

During sampling, a soil classification survey will be completed at the Ash Pits for use in the Environmental Evaluation. Several samples may also be collected form 0 to 2 feet for grain size analysis.

Stage 4 – Monitoring Well Installation, BAT Sampler (or equivalent) and Groundwater Sampling

A maximum of three alluvial monitoring wells will be installed downgradient of the Ash Pits between IHSS 133 and Woman Creek: preliminary locations are shown on Figure 7-3. The actual location, number and type of monitoring wells will be selected following the Stage 3 activities and after a review of the geologic characteristics of the site. This groundwater monitoring plan will be summarized in a TM, and submitted to the Agencies prior to implementation. Any wells that are proposed will be drilled according to SOP GT.2, installed according to SOP GT.6, and developed according to SOP GW.2. Following development, the wells will be sampled according to SOP GW.5 and GW.6. The wells will be screened to monitor the saturated section of the alluvium. If a water-bearing sandstone unit is found to be the first bedrock unit underlying the alluvium in a boring, an additional well will be completed in the sandstone unit at that location. It is possible, due to the limited saturated thickness of the alluvium,



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SCALE: 1" = 300'

EXPLANATION

- 115 — INDIVIDUAL HAZARDOUS SUBSTANCE SITE
- SW-1 — EXISTING SURFACE WATER SAMPLING LOCATION
- 5786 — EXISTING ALLUVIAL GROUNDWATER MONITORING WELL
- SED-17 — EXISTING SEDIMENT SAMPLING LOCATION
- 1474 — PRE-1986 MONITORING WELL
- PROPOSED SOIL BORING AND SURFACE SAMPLING LOCATION*
- PROPOSED WELL LOCATION
- INTERMITTENT STREAM
- DIRT ROAD

*ALL PROPOSED LOCATIONS ARE APPROXIMATE

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

OPERABLE UNIT 5
PHASE I RFI/RI WORK PLAN

PROPOSED SAMPLING & WELL LOCATIONS, ASH PITS 1-4, INCINERATOR, CONCRETE WASH PAD (IHSS 133.1-6), AND ADDITIONAL SURFACE DISTURBANCE

FIGURE 7-3

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that there may be locations where there is no water or times of the year when the saturated thickness is zero. If this is the case, it may be necessary to relocate the wells or possibly install a vadose zone sampling device such as the BAT sampler (or an equivalent) capable of characterizing the contaminant plumes in zones of limited water. The proper use and location of the monitoring devices should allow evaluation of groundwater contamination and contaminant migration. The need for bedrock wells will be evaluated after lithologic and preliminary contaminant data has been gathered and interpreted. The Phase I analytical program for samples collected from these wells is presented in Subsection 7.3. The results of the first round of sampling will be reported in the Phase I RI Report. The wells will be sampled quarterly for a minimum of 1 year.

7.2.3 IHSS - 142.10-11 - C-Series Detention Ponds

Stage 1 – Review of Existing Data

Surface water and sediment samples are currently being collected at locations in the Woman Creek drainage as part of ongoing monitoring activities at the Rocky Flats Plant. The sampling locations, methodology, analytical parameters, and results from this monitoring will be reviewed prior to the Phase I field investigation to assess the potential overlap between the programs. Data collected during the ongoing monitoring may satisfy the requirements of this OU5 program and will be utilized, if appropriate. Also, as specified in the IAG, the 1986 report "Trends in the Rocky Flats Surface Water Monitoring" (U.S. DOE 1986a) and other data pertaining to these ponds will be submitted to the EPA and the CDH.

Stage 2 – Surveys

No survey activities are proposed for this IHSS.

Stage 3 – Surface Water and Sediment Samples Collected in the C-Ponds, Woman Creek, and the SID

Five surface water samples will be collected from each of the two C-Series Detention Ponds (Table 7-3). At least one of the five water samples at each pond will be taken from the deepest part of the pond. As specified in the IAG, during the collection of this sample, the presence of stratification in the pond water will be evaluated. Stratification of the water column will be identified through temperature and/or dissolved oxygen measurements taken according to SOP SW.8. If stratification of the pond is identified at this location, grab water samples will be taken from each vertically stratified zone. The second surface water sample from each pond will be collected within 5 feet of the inlet to the pond. The third surface water sample for each pond will be collected within 5 feet of the pond spillway. The two remaining sample locations will be selected at random based on the size of the pond at the time of sample collection. The surface water sample collected at each location will consist of a composite sample from the entire vertical water column, except for the grab samples at the deepest sampling location (described above). Samples will be collected according to SOPs SW.1, SW.2, and SW.8 as

TABLE 7-3

PHASE I INVESTIGATION
IHSS 142.10-11 - C-SERIES DETENTION PONDS

Activity	Purpose	Location	Sample Number
Stage 1			
1. Review Existing Data	Determine usefulness of existing surface water and sediment samples	C-Ponds, Woman Creek and the SID	NA
Stage 2			
No Activity			
Stage 3			
2. Collect surface water samples	Characterize surface water contamination	5 locations in each pond and from each vertically stratified zone at the deepest point in the pond	16
3. Collect sediment samples in ponds	Characterize sediments in ponds and contamination	5 locations in each pond. Samples will also be taken from each 5-centimeter interval of sediment from the deepest part of each pond.	10
4. Collect sediment samples in other locations on Woman Creek	Characterize Woman Creek sediments and contamination	See Figure 7-2 and text	10
5. Collect sediment samples in the SID	Characterize SID sediments and contamination	See Figure 7-2 and text	2
Stage 4			
6. Install wells	Monitor alluvial groundwater downgradient of the ponds	Below ponds C-1 and C-2 dams (2 each)	4

NA = Not available

they apply to pond water sampling.

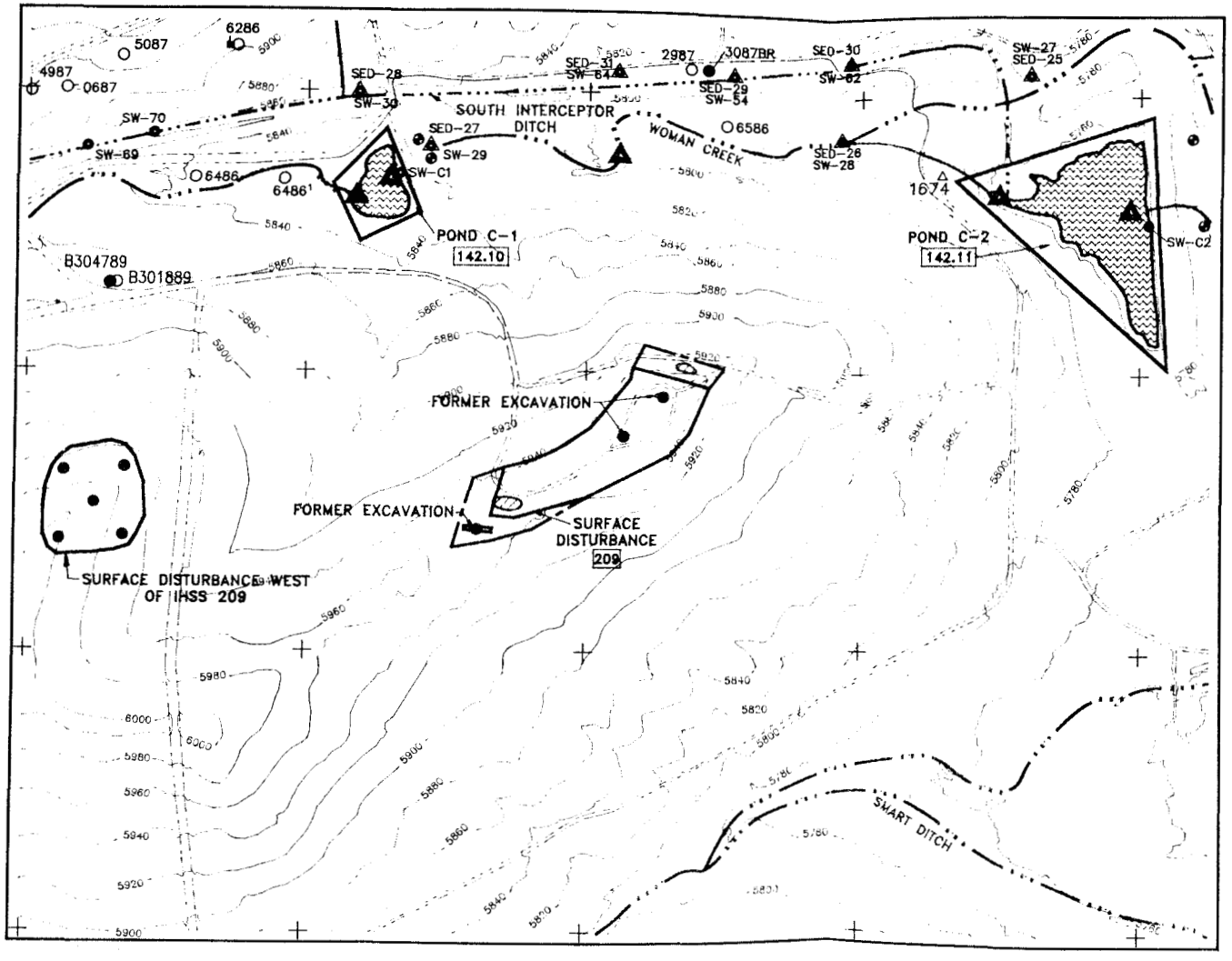
Five sediment samples will be collected from each of the two C-Series Detention Ponds (Figure 7-4). One of the five sediment samples will be taken within the pond 5 feet from the inlet. A second sediment sample will be collected from the deepest part of each pond. The other three samples will be taken from random at locations within the pond as it exists at the time of sampling. The top 2 inches of bed material will be collected for VOC analysis and a 6-inch core will be collected for analysis of all other parameters. Sediment samples will be geologically logged according to SOP GT.1.

In addition to the above samples, grab sediment samples will be collected from discrete vertical intervals in the sediment core taken from the deepest part of the pond. These sediment samples will consist of composite samples collected at 2-inch intervals in this core. Each of these samples will be analyzed by a gamma radiation scan.

Sediment samples will also be collected along Woman Creek from the Concrete Wash Pad (IHSS 133.6) to Indiana Street and along the SID (Figure 7-2). There already exists data on the sediments in the OU5 area (see Section 2.0). In developing the OU5 sediment sampling program, the areas where each IHSS would impact this drainage have been estimated so that the additional field sampling locations can be positioned downstream of these impact areas (Figure 7-5). These impact areas have been estimated by defining the area where surface water runoff from each IHSS intercept the drainage.

Based on these impact areas, additional field sampling locations have been positioned downgradient of each IHSS where there was a lack of existing data (Figure 7-5). Table 7-4 lists these additional sediment sampling locations proposed for OU5 and their purposes, along with what existing sediment locations will be used to characterize each area. The sediment samples collected from each pond are not included on Table 7-4. Generally, additional sampling locations are placed downstream of each IHSS and along each stream segment where existing data is lacking to characterize the stream sediment (Table 7-4 and Figure 7-5). Data from these additional sampling locations along with the sediment data that has already been collected will be used to evaluate Woman Creek and the SID in OU5 for the Phase I RI Investigation.

The sediment samples from Woman Creek and the SID will be collected within the creek or ditch at points that are conducive to the collection of sediment. The top 2 inches of bed material will be collected for VOC analysis and a 6-inch core will be collected for analysis of all other parameters. All sediment samples will be collected according to SOP SW.6 and the SOP Addendum (SOPA) to SOP SW.6 in Section 11.0 of this document. The chemical analyses that will be performed on these samples is presented in Subsection 7.3.



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SCALE: 1" = 400'

EXPLANATION

- 115 — INDIVIDUAL HAZARDOUS SUBSTANCE SITE
- SW-1 — EXISTING SURFACE WATER SAMPLING LOCATION
- 5786 — EXISTING ALLUVIAL GROUNDWATER MONITORING WELL
- SED-17 — EXISTING SEDIMENT SAMPLING LOCATION
- 3087 — EXISTING BEDROCK GROUNDWATER MONITORING WELL
- PONDLIKE DEPRESSION
- INTERMITTENT STREAM
- DIRT ROAD
- PRELIMINARY EXTENSION OF THE SURFACE DISTURBANCE BASED ON A SITE RECONNAISSANCE
- ORIGINAL STREAM CHANNEL NEAR POND C-2
- PROPOSED SOIL BORING AND SURFACE SAMPLE LOCATION *
- PROPOSED WELL LOCATION*
- PROPOSED SEDIMENT SAMPLING LOCATION**

**3 OTHER LOCATIONS IN EACH POND WILL BE SELECTED AT RANDOM

*ALL PROPOSED LOCATIONS ARE APPROXIMATE

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

OPERABLE UNIT 5
PHASE I RFI/RI WORK PLAN

PROPOSED SAMPLING & WELL LOCATIONS, IHSS 142.10-11, PONDS C-1 & C-2 iHSS 209 SURFACE DISTURBANCE, & THE SURFACE DISTURBANCE WEST OF IHSS 209

FIGURE 7-4

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Figure 7-5 Sediment Sampling Sites and IHSS Impact Areas Along the SID and Nearby Tributaries

Figure 7-5, continued

TABLE 7-4

PROPOSED SEDIMENT SAMPLING PROGRAM*

	IHSS or Stream Segment	Proposed Locations	Existing Locations	Purpose
1.	Ash Pits, Concrete Wash Pad, and Incinerator (Woman Creek)	2	SED-14 and SED-17	Characterize Woman Creek sediment downstream of IHSS 133
2.	Original Landfill (Woman Creek and SID)	4	0	Characterize sediments downstream of Landfill in both SID and Woman Creek
3.	Between IHSS 115 and Pond C-1	1	SED-126	Characterize sediments in SID and Woman Creek
4.	SID Between Pond C-1 and C-2	0	SED-28, SED-31, SED-29, and SED-30	Characterize SID
5.	Woman Creek between C-1 and C-2	1	SED-27, SED-26, and SED-25	Characterize Woman Creek between ponds
6.	Woman Creek between C-2 and Indiana Street	4	SED-1, SED-2, and SED-24	Characterize Woman Creek and Unnamed Ditch

* The 5 sediment samples for each pond are not included in this table.

Stage 4 – Monitoring Well Installation and Groundwater Sampling

Two monitoring wells will be installed immediately downgradient of each dam at Detention Ponds C-1 and C-2, thus providing a total of four monitoring wells in this area (Figure 7-4). The wells will be constructed within the original stream channel according to SOP GT.6 and will monitor the saturated alluvium. If a water-bearing sandstone unit is found to be the first bedrock unit underlying the alluvium in a boring, then an additional well will be completed in the sandstone at that location. Following development of the wells according to SOP GW.2, the wells will be sampled according to SOPs GW.5 and GW.6. Results of the first round of well sampling will be reported in the Phase I RI Report. These wells will be sampled quarterly for 1 year. The chemical analyses that will be performed on these samples are discussed in Subsection 7.3.

7.2.4 IHSS 209 - Surface Disturbance Southeast of Building 881 and Other Surface Disturbances

There are three surface disturbances that will be evaluated during the Phase I investigation: IHSS 209, the surface disturbance west of IHSS 209, and the surface disturbances south of the Ash Pits (Figures 7-3 and 7-4). The Phase I field sampling programs for these areas are similar and are described below. Table 7-5 summarizes the proposed program for these areas.

Stage 1 – Review Aerial Photographs

Available aerial photographs, including those from 1964, 1969, 1971, and 1983, will be reviewed to evaluate the nature and use of IHSS 209, the surface disturbance west of IHSS 209, and the surface disturbance south of the Ash Pits (see Table 7-5). These photos will help to determine if there are any specific areas within each of these surface disturbances that should be investigated more comprehensively. In addition, the features that appears to be a pond at IHSS 209 in a 1983 and 1988 aerial photo will be evaluated.

Stage 2 – Visual Inspection and Radiation Survey

A visual inspection will be conducted over the three surface disturbances to identify any stained soil and anomalous surface areas. A FIDLER radiation survey will also be performed at the areas according to SOP FO.16. This survey will be conducted randomly over each surface disturbance. If areas of anomalous radiation readings are detected, the survey will be adjusted to pinpoint the radiation source. The results of the surveys will be plotted on a map and contoured, if appropriate. The radiation surveys will be conducted using a side-shielded FIDLER and a shielded G-M pancake-type detector. If appropriate, the Stage 3 field sampling program will be adjusted to investigate anomalies identified from the Stage 2 visual inspection and radiation survey.

TABLE 7-5

PHASE I INVESTIGATION
IHSS 209 - SURFACE DISTURBANCE SOUTHEAST OF BUILDING 881, THE SURFACE DISTURBANCE WEST OF IHSS 209 AND THE SURFACE DISTURBANCES SOUTH OF THE ASH PITS

Activity	Purpose	Location	Sample Number
Stage 1			
1. Review Aerial Photographs	Evaluate nature and use of sites and nature of the ponds at IHSS 209	IHSS 209, surface disturbance west of IHSS 209 and surface disturbances south of the Ash Pits	NA
Stage 2			
2. Visual Inspection	Identify stained soil areas	IHSS 209, surface disturbance west of IHSS 209 and surface disturbances south of the Ash Pits	NA
3. Radiation Survey	Locate areas of anomalous radiation readings	Random survey over area	NA
Stage 3			
4. Sample Sediment and Surface Water	Characterize the two ponds on IHSS 209	From the center of the ponds at IHSS 209	2 each sediment and surface water
5. Soil Borings including 0-6-inch surface sample	Evaluate surface disturbances	IHSS 209 – 1 boring in each of the three former excavations; for the surface disturbance west of IHSS 209 1 boring in each of the five disturbed areas; for the disturbance south of Ash Pits, 2 in each of the three parallel excavations, 4 in west fill area, and 1 in east fill area.	19

NA - Not Applicable

Stage 3 – Sediment, Surface Water, Surface Soil, and Borehole Samples

A sediment sample and surface water sample, if present, will be collected from the deepest part of both pond-like depressions at IHSS 209 according to SOPs SW.1, SW.2, SW.3, and SW.6 (Figure 7-4).

Surface soil samples will be collected at 19 locations to characterize possible contamination in the surface soils (Figures 7-3 and 7-4). Samples will be collected according to the sampling procedures specified in SOP GT.8.

A total of 19 boreholes will be drilled and sampled in the surface disturbance areas (Figures 7-3 and 7-4). The borings will be drilled to a depth of 12 feet and will be drilled and sampled according to SOP GT.2. The borings will be logged according to SOP GT.1. Samples will be taken continuously. Discrete samples will be collected from every 2-foot increment and analyzed for the TCL VOCs. Two 6-foot composites will be analyzed for the TCL semivolatile organic compounds, the TAL metals, and radionuclides.

In addition, surface soil and subsurface samples will be collected at any areas of anomalous radiation readings or stained areas identified from the visual inspection and radiation surveys of these disturbed areas.

During sampling, a soil classification survey will be completed at the Surface Disturbances for use in the Environmental Evaluation. Several samples may also be collected from 0 to 2 feet for grain size analysis.

7.2.4.1 Area South of OU5 to the Property Boundary

Surface soils in the area south of the OU5 to the property boundary will be sampled for plutonium, americium, and uranium as part of OUs 1, 2, and 3 RFI/RIs. The Background and Site-Wide Sampling Programs for the Rocky Flats Plant will provide additional coverage for the area south of OU5 to the property boundary. For example, the Background Sampling Program includes sediment and surface water stations (SED-18 and -19; and SW-80, -104, and -130) for the Antelope Springs area and on Smart Ditch at the western boundary of the Plant. The Site-Wide Monitoring Activities will include sediment and surface water sampling in Pond C-1 and surface water sampling near Indiana Avenue. The exact station locations have not been finalized. The Background and Site-Wide Monitoring Programs use the same sampling protocols and Quality Assurance (QA)/Quality Control (QC) procedures as the OU programs. Therefore, the data will be comparable.

If the work done for OUs 1-3, the Background, or Site-Wide Sampling Activities detect any contaminants at significant levels (above acceptable risk range, background, or potential ARAR), further investigation of this area will be covered under the OU5 investigation.

7.2.5 Ambient Air Monitoring Program

Three Hi-Vol air sampling devices will be installed near the Woman Creek drainage to monitor the air pathway from this OU (Figure 7-2). One will be located northwest of the Ash Pits (IHSS 133) and the Old Landfill (IHSS 115) to provide background data. The second air monitoring station will be placed between the Ash Pits and the Old Landfill, with the third southeast of the Old Landfill.

The data obtained from these stations, as well as the existing nearby air stations, will be used to evaluate the air emissions from this area. There are currently seven air monitoring stations (S-10, S-11, S-13, S-14, S-23, S-37, and S-38) near the Woman Creek drainage (Figure 7-2). The three proposed monitoring stations will be sampled in accordance with the Site-Wide Ambient Air Monitoring Program currently being conducted by EG&G at the Rocky Flats Plant. Briefly, the operation and sampling procedures are described below.

Air coming in contact with the Hi-Vol Ambient Air samples is forced through a filter material, trapping radioactive particulates and other airborne matter for subsequent analysis. Performance data from these Radioactive Ambient Air Monitoring Program (RAAMP) air samplers are collected by Environmental Monitoring and Assessment Technologists (EMAT) on a weekly basis, and air filters are replaced every 2 weeks. Once a month, the two filters collected from each air monitoring station are composited, and one sample from each air monitoring station is sent to Radiological Health Labs (Building 123) at the Plant for analysis. Detailed procedures describing the air sampler operations, filter exchange, filter preparation for analysis, RAAMP documentation, and reporting requirements are contained in SOP AP.13. These air samples will be analyzed according to the procedures outlined in the General Radiochemistry and Routine Analytical Services Protocol (GRRASP). The samples will be analyzed for the same analytes as are analyzed in the site-wide program, which is currently plutonium. The analytical program for the site-wide Ambient Air Program is expected to be expanded in the near future to include other radionuclides, at which time the analytical program for the three proposed OU5 air stations will also be increased.

7.3 SAMPLE ANALYSIS

This section describes the sample handling procedures and analytical program for samples collected from the Phase I investigation. In this section, sample designations, analytical requirements, sample containers and preservation, and sample handling and documentation requirements will be discussed.

7.3.1 Sample Designations

All sample designations generated for this RFI/RI will conform to the input requirements of the Rocky Flats Environmental Database System (RFEDS). Each sample designation will contain a nine-character sample number consisting of a two-letter prefix identifying the media sampled (e.g., "SB" for soil borings, "SS" for stream sediments), a unique five-digit number, and a two-letter suffix identifying the contractor

(e.g., "WC" for Woodward-Clyde). One sample number will be required for each sample generated, including QA/QC samples. In this manner, 99,999 unique sample numbers are available for each contractor that contributes sample data to the data base. A block of numbers will be reserved for the Phase I RFI/RI sampling of OU5. Boring numbers will be developed independently of the sample numbers from a boring. Specific sample location numbers are not assigned at this time, pending the results of the aerial photograph analysis and review of existing data.

7.3.2 Analytical Requirements

Generally, samples collected during the Phase I RI will be analyzed for some or all of the following chemical and radionuclide parameters:

- Nitrate
- TAL metals
- Uranium 233/234, 235, and 238
- Transuranic elements (plutonium and americium)
- Cesium 137 and strontium 89/90
- Gross alpha and gross beta
- Tritium
- Total dissolved chromium (water only)
- Beryllium
- TCL volatile organics
- TCL semivolatile organics
- Total organic carbon (TOC)
- TCL pesticides/PCBs
- CO_3, HCO_3, Cl, SO_4, NO_3 (water only)

The specific analytes in the groups listed above and their detection/quantitation limits are contained in Table 7-6. Table 3-1 lists the analytical methods that will be used for each analyte. The specific Phase I analytical programs for each IHSS are contained in Table 7-7. Both filtered and unfiltered surface water and groundwater samples will be analyzed at each location.

The analytical program for each media at every IHSS is summarized in Table 7-7. The analytical program for each IHSS was developed in the IAG based on the type of waste suspected to be present at each site. The specific analytes and detection/quantitation limits are specified in the IAG by reference to Contract Laboratory Program (CLP) analyses. The GRRASP (EG&G 1990f) provides a listing of CLP analytes and limits that will be used for this Phase I RFI/RI. These analytes and limits are presented in Table 7-6. The program shown in Table 7-7 should address the bulk of chemicals and compounds that were handled or are suspected to be present at OU5 and enable detection of soil, sediment, surface water, and groundwater contamination, if present.

TABLE 7-6

PHASE I
SOIL, SEDIMENT, AND WATER SAMPLING PARAMETERS
AND DETECTION LIMITS

	DETECTION LIMITS*	
TARGET ANALYTE LIST - METALS	Water (ug/l)	Soil/Sediment (mg/kg)
Aluminum	200	40
Antimony	60	12
Arsenic	10	2
Barium	200	40
Beryllium	5	1.0
Cadmium	5	1.0
Calcium	5000	2000
Cesium	1000	200
Chromium	10	2.0
Cobalt	50	10
Copper	25	5.0
Cyanide	10	10
Iron	100	20
Lead	5	1.0
Lithium	100	20
Magnesium	5000	2000
Manganese	15	3.0
Mercury	0.2	0.2
Molybdenum	200	40
Nickel	40	8.0
Potassium	5000	2000
Selenium	5	1.0
Silver	10	2.0
Sodium	5000	2000
Strontium	200	40
Thallium	10	2.0
Tin	200	40
Vanadium	50	10.0
Zinc	20	4.0
TOTAL ORGANIC CARBON	1	1
	QUANTITATION LIMITS*	
TARGET COMPOUNDS LIST - VOLATILES	Water (ug/l)	Soil/Sediment (ug/kg)
Chloromethane	10	10
Bromomethane	10	10
Vinyl Chloride	10	10
Chloroethane	10	10
Methylene Chloride	5	5
Acetone	10	10
Carbon Disulfide	5	5
1,1-Dichloroethene	5	5
1,1-Dichloroethane	5	5

TABLE 7-6
(Continued)

PHASE I
SOIL, SEDIMENT, AND WATER SAMPLING PARAMETERS
AND DETECTION LIMITS

	QUANTITATION LIMITS*	
TARGET COMPOUNDS LIST - VOLATILES (Continued)	Water (µg/l)	Soil/Sediment (µg/kg)
total 1,2-Dichloroethene	5	5
Chloroform	5	5
1,2-Dichloroethane	5	5
2-Butanone	10	10
1,1,1-Trichloroethane	5	5
Carbon Tetrachloride	5	5
Vinyl Acetate	10	10
Bromodichloromethane	5	5
1,1,2,2-Tetrachloroethane	5	5
1,2-Dichloropropane	5	5
trans-1,3-Dichloropropene	5	5
Trichloroethene	5	5
Dibromochloromethane	5	5
1,1,2-Trichloroethane	5	5
Benzene	5	5
cis-1,3-Dichloropropene	5	5
Bromoform	5	5
2-Hexanone	10	10
4-Methyl-2-pentanone	10	10
Tetrachloroethene	5	5
Toluene	5	5
Chlorobenzene	5	5
Ethyl Benzene	5	5
Styrene	5	5
Total Xylenes		

	QUANTITATION LIMITS*	
TARGET COMPOUNDS LIST - SEMIVOLATILES	Water (µg/l)	Soil/Sediment (µg/kg)
Phenol	10	330
bis(2-Chloroethyl)ether	10	330
2-Chlorophenol	10	330
1,3-Dichlorobenzene	10	330
1,4-Dichlorobenzene	10	330
Benzyl Alcohol	10	330
1,2-Dichlorobenzene	10	330
2-Methylphenol	10	330
bis(2-Chloroisopropyl)ether	10	330
4-Methylphenol	10	330
N-Nitroso-di-n-dipropylamine	10	330
Hexachloroethane	10	330

TABLE 7-6
(Continued)

PHASE I
SOIL, SEDIMENT, AND WATER SAMPLING PARAMETERS
AND DETECTION LIMITS

TARGET COMPOUND LIST - SEMIVOLATILES (Continued)	QUANTITATION LIMITS* Water (µg/l)	Soil/Sediment (µg/kg)
Nitrobenzene	10	330
Isophorone	10	330
2-Nitrophenol	10	330
2,4-Dimethylphenol	10	330
Benzoic Acid	50	1600
bis(2-Chloroethoxy)methane	10	330
2,4-Dichlorophenol	10	330
1,2,4-Trichlorobenzene	10	330
Naphthalene	10	330
4-Chloroaniline	10	330
Hexachlorobutadiene	10	330
4-Chloro-3-methylphenol(para-chloro-meta-cresol)	10	330
2-Methylnaphthalene	10	330
Hexachlorocyclopentadiene	10	330
2,4,6-Trichlorophenol	10	330
2,4,5-Trichlorophenol	50	1600
2-Chloronaphthalene	10	330
2-Nitroaniline	50	1600
Dimethylphthalate	10	330
Acenaphthylene	10	330
2,6-Dinitrotoluene	10	330
3-Nitroaniline	50	1600
Acenaphthene	10	330
2,4-Dinitrophenol	50	1600
4-Nitrophenol	50	1600
Dibenzofuran	10	330
2,4-Dinitrotoluene	10	330
Diethylphthalate	10	330
4-Chlorophenyl Phenyl ether	10	330
Fluorene	10	330
4-Nitroaniline	50	1600
4,6-Dinitro-2-methylphenol	50	1600
N-nitrosodiphenylamine	10	330
4-Bromophenyl Phenylether	10	330
Hexachlorobenzene	10	330
Pentachlorophenol	50	1600
Phenanthrene	10	330
Anthracene	10	330
Di-n-butylphthalate	10	330
Fluoranthene	10	330
Pyrene	10	330
Butylbenzylphthalate	10	330

TABLE 7-6
(Continued)

PHASE I
SOIL, SEDIMENT, AND WATER SAMPLING PARAMETERS
AND DETECTION LIMITS

TARGET COMPOUND LIST - SEMIVOLATILES (Continued)	Water (µg/l)	Soil/Sediment (µg/kg)
3,3'-Dichlorobenzidine	20	660
Benzo(a)anthracene	10	330
Chrysene	10	330
bis(2-Ethylhexyl)phthalate	10	330
Di-n-octylphthalate	10	330
Benzo(b)fluoranthene	10	330
Benzo(k)fluoranthene	10	330
Benzo(a)pyrene	10	330
Indeno(1,2,3-cd)pyrene	10	330
Dibenz(a,h)anthracene	10	330
Benzo(g,h,i)perylene	10	330

TARGET COMPOUND LIST - PESTICIDES/PCBS	QUANTITATION LIMITS*	
	Water µg/l	Soil/Sediment µg/kg
alpha-BHC	0.05	8.0
beta-BHC	0.05	8.0
delta-BHC	0.05	8.0
gamma-BHC (Lindane)	0.05	8.0
Heptachlor	0.05	8.0
Aldrin	0.05	8.0
Heptachlor epoxide	0.05	8.0
Endosulfan I	0.05	8.0
Dieldrin	0.10	16.0
4,4'-DDD	0.10	16.0
Endrin	0.10	16.0
Endosulfan II	0.10	16.0
4,4'-DDD	0.10	16.0
Endosulfan sulfate	0.10	16.0
4,4'-DDT	0.10	16.0
Methoxychlor	0.5	80.0
Endrin ketone	0.10	16.0
alpha-Chlordane	0.5	80.0
gamma-Chlordane	0.5	80.0
Toxaphene	1.0	160.0
Aroclor-1016	0.5	80.0
Aroclor-1221	0.5	80.0
Aroclor-1232	0.5	80.0
Aroclor-1242	0.5	80.0
Aroclor-1248	0.5	80.0
Aroclor-1254	1.0	160.0
Aroclor-1260	1.0	160.0

TABLE 7-6
(Concluded)

PHASE I
SOIL, SEDIMENT, AND WATER SAMPLING PARAMETERS
AND DETECTION LIMITS

	REQUIRED DETECTION LIMITS*	
RADIONUCLIDES	Water (pCi/ℓ)	Soil/Sediment (pCi/g)
Gross Alpha	2	4 dry
Gross Beta	4	10 dry
Uranium 233+234, 235, and 238 (each species)	0.6	0.3 dry
Americium 241	0.01	0.02 dry
Plutonium 239+240	0.01	0.03 dry
Tritium	400	400 (pCi/ml)
Cesium 137	1	0.1 dry
Strontium 89+90	1	1 dry

	DETECTION LIMITS*
Parameters Exclusively for Groundwater Samples	Water (mg/ℓ)
ANIONS	
Carbonate	10
Bicarbonate	10
Chloride	5
Sulfate	5
Nitrate as N	5
FIELD PARAMETERS	
pH	0.1 pH unit
Specific Conductance	1
Temperature	
Dissolved Oxygen	0.5
Barometric Pressure	
INDICATORS	
Total Dissolved Solids	5

- Detection and quantitation limits are highly matrix dependent. The limits listed here are the minimum achievable under ideal conditions. Actual limits may be higher.

TABLE 7-7

PHASE I ANALYTICAL PROGRAM

IHSS	Location	Media	Total Cr	Be	H3	Nitrate	Gross ∝	Gross β	U 233/234	U 235	U 238	Pu 239/240	Am 241
115	Borings to confirm soil gas	Soil											
	Borings transecting plumes grabs from 2-ft. intervals 6-ft composites	Soil Soil		X			X	X	X	X	X	X	X
	Wells downgradient of unit	Water	X	X		X	X	X	X	X	X	X	X
	Effluent from pipes	Water	X	X		X	X	X	X	X	X	X	X
	Sediments in SID and Woman Creek	Seds.		X			X	X	X	X	X	X	X
	Water in SID and Woman Creek	Water		X			X	X	X	X	X	X	X
	Randomly selected surface soil samples	Soil		X			X	X	X	X	X	X	X
	Surface Soil RAD anomalies	Soil					X	X	X	X	X	X	X
133	Borings on 25-ft. centers	Soil					X	X	X	X	X	X	X
	Randomly collected surface samples	Soil		X			X	X	X	X	X	X	X
	Surface soil RAD anomalies	Soil					X	X	X	X	X	X	X
	Sediment samples downstream of ash pits	Seds.	X	X	X	X	X	X	X	X	X	X	X
	Wells downgradient of unit	Water	X	X			X	X	X	X	X	X	X
142	Sediment samples in Woman Creek, SID and ponds	Seds.	X	X	X	X	X	X	X	X	X	X	X
	Water samples from ponds	Water	X	X	X	X	X	X	X	X	X	X	X
	Wells downgradient of C-1 and C-2	Water	X	X	X	X	X	X	X	X	X	X	X
209	Sediment in former ponds	Seds.					X	X	X	X	X	X	X
	Water in former ponds	Water					X	X	X	X	X	X	X
	Soil in small depressions	Soil					X	X	X	X	X	X	X
	Borings in area 0-6-inch 2-ft. intervals 6-ft composites	Soil					X X	X X	X X	X X	X X	X X	X X

TABLE 7-7
(Concluded)
PHASE I ANALYTICAL PROGRAM

IHSS	Location	Media	TAL Metals	TOC	TCL Vols	TCL Semi V	TCL Pest	Filtered									
								U	Pu 239/240	Cs 137	Sr 89/90	Am 241	Pb	Total Cr	TAL Metals	Be	Anions TDS
115	Borings to confirm soil gas	Soil			X		X										
	Borings transecting plumes																
	grabs from 2-ft. intervals	Soil			X												
	6-ft. composites	Soil	X			X	X										
	Wells downgradient of unit	Water	X		X	X		X	X	X	X	X	X	X			X
	Effluent from pipes	Water	X		X	X	X	X	X	X	X	X	X	X			X
	Sediments in SID and Woman Creek	Seds.	X		X	X	X	X	X	X	X	X	X	X			
	Water in SID and Woman Creek	Water	X		X	X	X	X	X	X	X	X	X	X			X
	Surface soil samples		X	X		X	X										
	Surface soil RAD anomalies																
133	Borings on 25-ft. centers	Soil	X														
	Surface soil samples	Soil	X	X													
	Surface soil RAD anomalies																
	Sediment samples downstream of ash pits	Seds.	X	X													
	Wells downgradient of unit	Water	X		X	X		X	X	X	X	X				X	X
142	Sediment samples in Woman Creek, SID, and Ponds	Seds.	X	X	X	X	+										
	Water samples from ponds	Water	X		X	X		X	X	X	X	X			X	X	X
	Wells downgradient of C-1 and C-2	Water	X		X	X		X	X	X	X	X			X	X	X
209	Sediment in former ponds	Seds.	X		X	X	X										
	Water in former ponds	Water	X		X	X											
	Soil in small depressions	Soil	X	X	X	X	X										
	Borings in area	Soil															
	0-6-inch – surface soil		X	X	X	X											
	2-ft. intervals				X												
	6-ft. composites		X	X		X											

+ TCL pesticides will be analyzed for Ponds C-1 and C-2 sediment samples only.

Nitrates are included because low-level radioactive wastes with high nitrate concentrations may be present in Woman Creek or the SID. Metals were probably disposed of at OU5; however, details are not well known. Therefore, all of the TAL metals have been selected for Phase I analysis.

Uranium is likely to have been a constituent of the wastes at OU5. The isotopes U-233, U-234, U-235, and U-238 have been selected for analysis in Phase I. Plutonium is the only transuranic element that is used on the site. However, americium is a daughter product of plutonium and is found at the Rocky Flats Plant. Therefore, plutonium and americium have also been selected as Phase I radionuclide parameters. Gross alpha and gross beta are included as screening parameters because they are useful indicators of radionuclides. Tritium, strontium, and cesium are also included in the analytical program.

Volatile and semivolatile organics may have been handled at OU5 in small quantities probably only at the Original Landfill. The specific compounds used are unknown; therefore, all of the TCL volatile and semivolatile organics will be included in the Phase I analyses for some samples.

TCL pesticides/PCBs and TOC have been included for some samples to provide data for the environmental evaluation. For the sediment samples collected from Woman Creek and the SID, TCL pesticides will be analyzed in the samples collected from the detention ponds and at the location just downgradient from the Original Landfill. The other sediment samples collected from Woman Creek and the SID will not be analyzed for TCL pesticides as no pesticides have been detected to date from the extensive sampling already performed (see Section 2.0). In addition, the two proposed sediment sampling locations just downstream of the Ash Pit will not be analyzed for TCL volatiles and semivolatiles since incineration would probably have destroyed these organics.

The analytical parameters for the soil gas survey at IHSS 115 are 1,1,1-trichloroethane (TCA), dichloromethane, benzene, carbon tetrachloride, tetrachloroethene (PCE), and trichloroethene (TCE). Detection limits proposed for these parameters during the soil gas survey are listed in Table 7-8.

7.3.3 Sample Containers and Preservation

Sample volume requirements, preservation techniques, holding times, and container material requirements are dictated by the media being sampled and by the analyses to be performed. The soil matrices to be analyzed will include soils and sediments. The water matrices for analysis will include surface water and groundwater. Tables 7-9 and 7-10 list analytical parameters of interest in OU5 for water and soil matrices, along with the associated container size, preservatives (chemical and/or temperature), and holding times. Additional specific guidance on the appropriate use of containers and preservatives is provided in SOP FO.13, Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples.

TABLE 7-8
PHASE I INVESTIGATION
SOIL GAS PARAMETERS AND
PROPOSED DETECTION LIMITS

IHSS-115 Original Landfill

Volatiles	Detection Limit
1,1,1 TCA	1 $\mu g/\ell$
Dichloromethane	1 $\mu g/\ell$
Benzene	1 $\mu g/\ell$
Carbon Tetrachloride	1 $\mu g/\ell$
PCE	1 $\mu g/\ell$
TCE	1 $\mu g/\ell$

NOTE: Detection limits are a function of the detector type and injection volume. Thus, the detection limit may vary.

TABLE 7-9

SAMPLE CONTAINERS, SAMPLE PRESERVATION, AND SAMPLE HOLDING TIMES FOR WATER SAMPLES

Parameter	Container	Preservative	Holding Time
Liquid - Low to Medium Concentration Samples			
Organic Compounds:			
Purgeable Organics (VOCs)	2 x 40-mℓ VOA vials with teflon-lined septum lids	Cool, 4°C[a] with HCl to pH<2	7 days 14 days
Extractable Organics (BNAs), Pesticides and PCBs	1 x 4-ℓ amber[b] glass bottle	Cool, 4°C[a]	7 days until extraction, 40 days after extraction
Inorganic Compounds:			
Metals (TAL)	1 x 1-ℓ polyethylene bottle	Nitric acid pH<2; Cool, 4°C	180 days[c]
Cyanide	1 x 1-ℓ polyethylene bottle	Sodium hydroxide[d] pH>12; Cool, 4°C	14 days
Anions	1 x 1-ℓ polyethylene bottles	Cool, 4°C	14 days
Sulfide	1 x 1-ℓ polyethylene bottle	1 mℓ-zinc acetate sodium hydroxide to pH>9; Cool, 4°C	7 days
Nitrate	1 x 1-ℓ polyethylene bottle	Cool, 4°C	48 hours
Total Dissolved Solids (TDS)	1 x 1-ℓ polyethylene bottle	Cool, 4°C	48 hours
Radionuclides	1 x 1-ℓ polyethylene bottle	Nitric acid pH<2;	180 days

[a] Add 0.008% sodium thiosulfate ($Na_2S_2O_3$) in the presence of residual chlorine

[b] Container requirement is for any or all of the parameters given.

[c] Holding time for mercury is 28 days.

[d] Use ascorbic acid only if the sample contains residual chlorine. Test a drop of sample with potassium iodine-starch test paper; a blue color indicates need for treatment. Add ascorbic acid, a few crystals at a time, until a drop of sample produces no color on the indicator paper. Then add an additional 0.6g of ascorbic acid for each liter of sample volume.

TABLE 7-10

SAMPLE CONTAINERS, SAMPLE PRESERVATION, AND SAMPLE HOLDING TIMES FOR SOIL SAMPLES

Parameter	Container	Preservative	Holding Time
Soil or Sediment Samples - Low to Medium Concentration			
Organic Compounds:			
Purgeable Organics (VOCs)	1 x 4-oz wide-mouth teflon-lined glass vials	Cool, 4°C	14 days
Extractable Organics (BNAs), Pesticides and PCBs	1 x 8-oz wide-mouth teflon-lined glass vials	Cool, 4°C	7 days until extraction, 40 days after extraction
Inorganic Compounds:			
Metals (TAL)	1 x 8-oz wide-mouth glass jar	Cool, 4°C	180 days[1]
Cyanide	1 x 8-oz wide-mouth glass jar	Cool, 4°C	14 days
Sulfide	1 x 8-oz wide-mouth glass jar	Cool, 4°C	28 days
Nitrate	1 x 8-oz wide-mouth glass jar	Cool, 4°C	48 hours
Radionuclides	1 x 1-ℓ wide-mouth glass jar	None	45 days

[1]Holding time for mercury is 28 days.

7.3.4 Sample Handling and Documentation

Sample control and documentation is necessary to ensure the defensibility of data and to verify the quality and quantity of work performed in the field. Accountable documents include logbooks, data collection forms, sample labels or tags, chain-of-custody forms, photographs, and analytical records and reports. Specific guidance defining the necessary sample control, identification, and chain-of-custody documentation is discussed in SOP FO.14.

7.3.5 Data Reporting Requirements

Field data will be input into the RFEDS using a remote data entry module supplied by EG&G. Data will be entered on a timely basis and a 3.5-inch diskette will be delivered to EG&G. A hard copy report will be generated from the module for contractor use. The data will be put through a prescribed QC process based on SOP FO.14 to be generated by EG&G.

A sample tracking spreadsheet will be maintained by the contractor for use in tracking sample collection and shipment. EG&G will supply the spreadsheet format and will stipulate the timely reporting of the information. This data will also be delivered to EG&G on 3.5-inch diskettes. Computer hardware and software requirements for contractors using government supplied equipment will be supplied by EG&G. Computer and data security will also follow acceptable procedures outlined by EG&G.

7.4 FIELD QC PROCEDURES

Sample duplicates, field preservation blanks, and equipment rinsate blanks will be prepared. Trip blanks will be obtained from the laboratory. The analytical results obtained for these samples will be used by the Environmental Restoration (ER) Project Manager to assess the quality of the field sampling effort. The types of field QC samples to be collected and their application are discussed below. The frequency for QC samples to be collected and analyzed is provided in Table 7-11.

Duplicate samples will be collected by the sampling team and will be used as a relative measure of the precision of the sample collection process. These samples will be collected at the same time, using the same procedures, the same equipment, and in the same types of containers as required for the samples. They will also be preserved in the same manner and submitted for the same analyses as required for the samples.

Field preservation blanks of distilled water, preserved according to the preservation requirements (Subsection 7.3.3), will be prepared by the sampling team and will be used to provide an indication of any contamination introduced during field sample preparation technique. As indicated by Table 7-11, these QC samples are applicable only to samples requiring chemical preservation. Equipment (rinsate) blanks will be collected from a final decontamination rinse to evaluate the success of the field sampling team's decontamination efforts on nondedicated sampling equipment.

TABLE 7-11

FIELD QC SAMPLE FREQUENCY

Sample Type	Type of Analysis	Media	
		Solids	Liquids
Duplicates	Organics	1/10	1/10
	Inorganics	1/10	1/10
	Radionuclides	1/10	1/10
Field Preservation Blanks	Organics	NA	NA
	Inorganics	NA	1/20
	Radionuclides	NA	1/20
Equipment Rinsate Blanks	Organics	1/20	1/20
	Inorganics	1/20	1/20
	Radionuclides	1/20	1/20
Trip Blanks	Organics (Volatiles)	NR	1/20
	Inorganics	NR	NR
	Radionuclides	NR	NR

NA = Not Applicable
NR = Not Required

Equipment blanks are obtained by rinsing cleaned equipment with distilled water prior to sample collection. The rinsate is collected and placed in the appropriate sample container. Equipment rinsate blanks are applicable to all analyses for water and soil samples as indicated in Table 7-11.

Trip blanks consisting of deionized water will be prepared by the laboratory technician and will accompany each shipment of water samples for volatile organic analysis. Trip blanks will be stored with the group of samples with which they are associated. Analysis of the trip blank will indicate migration of volatile organics or problems associated with the shipment, handling, or storage of the samples.

Procedures for monitoring field QC are given in the site-wide Quality Assurance Project Plan (QAPjP).

8.0 BASELINE HEALTH RISK ASSESSMENT PLAN

8.1 OVERVIEW

A baseline health risk assessment will be prepared for Operable Unit Number 5 (OU5) as part of the Phase I RCRA Facility Investigation (RFI)/Remedial Investigation (RI) report. Both a human health evaluation and an environmental evaluation will be performed. This section describes the human health risk assessment. The environmental risk assessment is described in Section 9.0 of this Work Plan.

The purpose of the Phase I baseline risk assessment is to provide an estimate of potential health risks that may result from releases of hazardous substances from OU5 in the absence of any remedial action. Risks will be calculated for both on-site and off-site exposures to contaminants released and/or transported from the Individual Hazardous Substance Sites (IHSSs), using available data as well as data collected during the Phase I investigation of the unit.

The purpose of the baseline risk assessment is to provide information useful in determining the following, as described in the National Contingency Plan:

- A determination of whether the contaminants of concern identified at the site pose a current or potential risk to human health in the absence of any remedial action
- A determination of whether remedial action is necessary at IHSS's within the unit, and an identification of the media needing remediation
- A justification for performing remedial actions

This assessment will follow the guidance provided by the Environmental Protection Agency. It will also make use of additional information and methods that will facilitate interpretation of the results of the risk assessment. EPA publications that will be consulted when performing the health risk assessment include the following:

- Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). Interim Final. 1989. EPA/540/1-89/002.
- Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. Interim Final. 1988.
- Superfund Exposure Assessment Manual. 1988. EPA/540/1-88/001.
- Exposure Factors Handbook. 1989. EPA/600/8-89/043.
- Guidance for Data Useability in Risk Assessment. Interim Final. 1990. EPA/540/G-90/008.

9.0 ENVIRONMENTAL EVALUATION

9.1 INTRODUCTION

The objective of this Environmental Evaluation Work Plan is to provide a framework for addressing and quantifying the ecological effects to the biotic environment (plants, animals, microorganisms) from exposure to contaminants resulting from IHSSs within the Woman Creek Drainage, OU5. An ecosystem approach will be used as the basis for this environmental evaluation to ensure that ecological effects or endpoints (e.g., structural diversity, biomass, phenology, nutrient cycling, trophic structure) are addressed as well as populations and individuals that are more traditionally evaluated in a risk assessment approach (U.S. EPA 1989d). The ecosystem approach is comprehensive in that it initially addresses all ecosystem components, then progressively focuses on those aspects of the system potentially affected by contamination. The result of this process will be an evaluation of the nature and extent of contamination in biota, its relationship to abiotic sources, and the type and extent of adverse effects at the ecosystem, population, and individual levels of organization, as appropriate.

This plan is prepared in conformance with the requirements of current applicable legislation, including the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and follows the guidance for such studies as provided in the National Contingency Plan (NCP) and Environmental Protection Agency (EPA) documents for the conduct of Resource Conservation and Recovery Act (RCRA) Facility Investigation/ Remedial Investigation (RFI/RI) activities. Specifically, the EPA guidance provided in Risk Assessment Guidance for Superfund, Vol. II, Environmental Evaluation Manual (U.S. EPA 1989c) is followed. Although a formal Natural Resource Damage Assessment (NRDA) process has not been initiated at Rocky Flats as of this time, this work plan was also designed to be consistent with the NRDA process to the maximum extent possible.

Determination of the effects on biota will be performed in conjunction with the human health risk assessment for OU5. Where appropriate, criteria necessary for performing the environmental evaluation will be developed in conjunction with human health risk assessments and environmental evaluations for all Rocky Flats Plant operable units (OUs). Information from the environmental evaluation will assist in determining the form, feasibility, and extent of remediation necessary for Woman Creek Drainage in accordance with CERCLA.

During preparation of this work plan, several documents were reviewed as part of an assessment of available information. These included the Final Environmental Impact Statement (EIS), Rocky Flats Plant (U.S. DOE 1980); Wetlands Assessment (EG&G 1990g); Draft Environmental Evaluation Work Plan for OU2 (in RFI/RI Work Plan, EG&G 1991d); and the Final Phase III RFI/RI Work Plan, 881 Hillside Area (U.S. DOE 1990c) among others. Literature reviews will continue throughout the environmental evaluation. Review of this Draft Phase I RFI/RI Work Plan for OU5 and the Environmental Evaluation Work Plans for OU1 (U.S. DOE 1990c) and OU2 (EG&G 1991d) formed the basis for the establishment of the initial sampling locations presented in the OU5 Environmental Evaluation Field Sampling Plan (Subsection 9.3).

9.1.1 Approach

This plan presents a comprehensive approach to conducting the environmental evaluation at Woman Creek Drainage. This comprehensive approach is designed to ensure that all procedures to be performed are appropriate, necessary and sufficient to adequately characterize the nature and extent of environmental effects to biota under the "no action" scenario. The approach presented in this plan is adapted from the toxicity-based approach to the assessment of ecosystem effects (U.S. EPA 1989c, 1989d). The approach is based on standard risk assessment concepts whereby uncertainties concerning potential ecosystem effects are explicitly recognized and, where possible, quantified. The planned approach is also based, to the greatest extent possible, on providing objective estimates of ecological damage and the establishing a firm, causal relationship between contamination and ecological effects. To establish this relationship, the Work Plan focuses on the obtainment of three types of information:

- Chemical - Chemical analyses of appropriate media to establish the presence, concentrations, and variabilities of specific toxic compounds. This effort will be conducted under the RFI/RI abiotic sampling program.

- Ecological - Ecological surveys to characterize the condition of existing communities and establish whether any adverse effects have occurred.

- Toxicological - Toxicological and ecotoxicological testing to establish the link between adverse ecological effects and known contamination.

Without these three types of data, other potential causes of the observed effects on ecosystems unrelated to the presence of contamination, such as habitat alterations and natural variability, cannot be eliminated.

The ecological assessment scheme adopted for this project blends standard environmental and risk assessment methods with ecological and toxicological modeling to produce an integrated procedure for selecting contaminants of concern and indicator species, and for conducting an investigation of ecosystem effects resulting from contamination. As is recommended by EPA, this environmental

TITLE: Quality Assurance Addendum

Approved By: [signature] 2/27/92
Name (Date)

This is a CONTROLLED DOCUMENT
RFSO – ROCKY FLATS SITE OFFICE
ENVIRONMENTAL MANAGEMENT DEPARTMENT
This is a RED Stamp

10.0 QUALITY ASSURANCE ADDENDUM

The following document is the Quality Assurance Addendum which establishes the specific quality assurance controls applicable to the field investigation activities described in this RFI/RI Work Plan for OU5. This document was developed separately from the other sections of this report; therefore, this section is formatted differently. This section includes a separate table of contents, and the pages are numbered sequentially instead of sectionally.

TITLE: Standard Operating Procedures and Addenda

Approved By:
Name (Date) 2/29/92

11.0
STANDARD OPERATING PROCEDURES AND ADDENDA

The following Rocky Flats Plant (RFP) program-wide Standard Operating Procedures (SOPs) will be used during the specific field investigations for Operable Unit Number 5 (OU5):

- FO.13 Containerizing, Preserving, Handling and Shipping Soil and Water Samples
- FO.14 Data Base Management
- FO.16 Field Radiological Measurements
- GW.1 Water Level Measurements in Wells and Piezometers
- GW.2 Well Development
- GW.5 Measurement for Groundwater Field Parameters
- GW.6 Groundwater Sampling
- GT.1 Logging Alluvial and Bedrock Material
- GT.2 Drilling and Sampling Using Hollow-Stem Auger Techniques
- GT.6 Monitoring Well and Piezometer Installation
- GT.8 Surface Soil Sampling
- GT.9 Soil Gas Sampling and Field Analysis
- GT.10 Borehole Clearing
- SW.1 Surface Water Data Collection Activities
- SW.2 Field Measurement of Surface Water Field Parameters
- SW.3 Surface Water Sampling
- SW.6 Sediment Sampling
- SW.8 Pond Sampling
- AP.13 Radioactive Ambient Air Monitoring Program

In addition, Field Operations, Volume I, SOPs will also be used, as appropriate, during field operations.

Specific information concerning sampling activities is provided in the Field Sampling Plan (FSP) (Section 7.0) for most of the sampling activities. Project-specific details for this work plan will be included in the Standard Operating Procedures Addenda (SOPAs). These SOPAs will be attached to the SOP for use during field activities.

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